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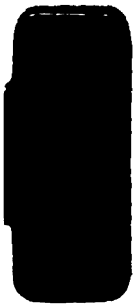
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**REPORTS**  
**OF THE**  
**DEPARTMENT OF COMMERCE**

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**1917**

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**REPORT OF THE SECRETARY OF COMMERCE**  
**AND**  
**REPORTS OF BUREAUS**



**WASHINGTON**  
**GOVERNMENT PRINTING OFFICE**  
**1918**



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**REPORT**  
**OF THE**  
**SECRETARY OF COMMERCE**

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ANNUAL REPORT  
OF THE  
SECRETARY OF COMMERCE.

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DEPARTMENT OF COMMERCE,  
OFFICE OF THE SECRETARY,  
*Washington, October 30, 1917.*

To the PRESIDENT:

I have the honor to submit herewith my fifth annual report, covering the operations and condition of the Department during the fiscal year which ended June 30, 1917. It traces in a general way its operations to October 1, 1917.

The organization of the Department was not changed during the fiscal year except that on April 1, 1917, the cost of production division of the Bureau of Foreign and Domestic Commerce was transferred to the Tariff Commission under act approved September 8, 1916.

**Travel Allowance to Department Employees.**

In Appendix A the matter of travel allowance (to which I have referred in two previous reports) is separately discussed. The unjust practice still continues of requiring employees drawing modest pay to travel on Government business largely at their own expense. There is no excuse for the practice. It is easy to change it and by publicity and responsibility to provide all necessary safeguards.

**Removal of Federal Trade Commission.**

The Federal Trade Commission left the quarters it had long occupied in the Commerce Building on August 22, 1917. The space it had used was immediately occupied by the growing services of the Department.

**Representatives to Meetings and Conventions.**

By special provision of law the Bureau of Standards may and does send representatives to meetings and conventions of a scientific character at public expense. A scientific officer, however, of

the Coast and Geodetic Survey or of the Bureau of Fisheries is refused that privilege. We may collect at public expense from foreign lands information for the business world. We are not, however, permitted at public expense to convey that information to a meeting or convention of the same business world. In like manner an officer of the Bureau of the Census may need to address a meeting of manufacturers on the subject of the census of manufactures. If he goes, he must pay his own expenses or the manufacturers must pay them for him, as the law now stands. Two scientific representatives of the Department may travel from Washington to the same meeting—one from the Bureau of Fisheries, the other from Standards. The former must pay his own bills or have them paid by private parties. The latter would have them paid by the Government although the errand was the same. The condition is not only absurd but humiliating to many an officer who desires to do a public service.

#### **Vessels of the Department's Marine Services.**

The first-class seagoing lighthouse tender *Cedar*, for service in Alaska, was conditionally accepted June 30, 1917.

The shallow-draft lighthouse tender *Palmetto*, for service in the inland waters of the sixth lighthouse district, was completed March 19, 1917.

The stern-wheel lighthouse tender *Dandelion*, for use on the upper Mississippi River, was acquired by purchase and went into commission April 7, 1917.

New light vessel *No. 101* was placed on station off Cape Charles, Va., on October 4, 1916.

New light vessel *No. 102* was placed on station at Southwest Pass, entrance to the Mississippi River, La., on February 24, 1917.

The only vessel now under construction is the third-class light vessel *No. 99*, for service on the Great Lakes. Favorable progress was made up to July 10, 1917, when a fire of unknown origin damaged the vessel beyond repair. The contractors have commenced the work of rebuilding, but the approximate time of completion can not be determined at present.

The Coast Survey steamer *Surveyor* was accepted on June 11, 1917. The steamer *Taku* of the same service was condemned September 27, 1917, and ordered sold as unfit for further use.

The Fisheries steamer *Halcyon* was completed on May 3, 1917, and the two motor launches *Murre* and *Auklet*, for use in Alaska, were accepted on May 10.

The Navigation Service vessel *Kilkenny* was purchased on August 6, 1917. The purchase price, however, for the vessel was returned by the former owner with a note presenting the vessel to the Government.

The Department had the following vessels in its marine services on October 1, 1917:

Service.	In operation.	Not in operation.	Being built.	Temporarily loaned to Navy Department.	Total.
Coast and Geodetic Survey.....	5	1	0	3	9
Bureau of Navigation.....	2	0	0	1	3
Bureau of Lighthouses:					
Tenders.....	3	0	0	47	50
Light vessels.....	64	0	1	4	69
Bureau of Fisheries.....	11	1	0	1	13
Total.....	85	2	1	56	144

This is exclusive of 4 vessels loaned to the Coast and Geodetic Survey by the Philippine Government and of 48 motor boats of all sizes operated by the Bureau of Fisheries.

By Executive proclamation dated April 11, 1917, certain vessels, personnel, and stations of the Lighthouse Service were turned over to the use of the Army and Navy. Forty-nine vessels, 1,120 officers and men, and 21 stations were thus transferred. In addition to the vessels transferred under the above Executive order, the tender *Palmetto* was later turned over to the Navy with 4 officers and 7 members of the crew. The tender *Gardenia* was also loaned to the Navy but without complement.

By Executive order dated September 24, 1917, the steamers *Isis*, *Surveyor*, and *Bache*, of the Coast and Geodetic Survey, with their officers were transferred to the Navy. At the same time 38 officers were transferred to the naval service and 29 to the Army, and also 10 of the technical office force to the Army.

The Fisheries vessels *Albatross*, *Fish Hawk*, *Phalarope*, and *Grampus* were tendered to the Navy on May 19, 1917. The *Phalarope* is placed at the service of the commanding officer of the Woods Hole naval station for use during the winter of 1917-18, with the understanding that the Bureau of Fisheries may utilize her whenever needed.

The *Fish Hawk* is doing similar naval service with a like understanding.

The *Albatross*, now in California, has been accepted, as this report is written for naval service.

On July 31, 1917, the motor vessel *Dixie*, of the Navigation Service, was transferred to the naval service.

In all, 61 vessels have been tendered or transferred with a personnel of 269 officers and 1,090 men.

#### **Indictments Resulting from "Eastland" Disaster.**

The courts have not acted under existing indictments in the matter of the licensed officers who were in charge of the steamer *Eastland* when she sank. Therefore the suspended inquiry into the conduct of these officers has not been concluded. The attention of the proper authorities has been called without result to the delay of over two years and to its result in preventing the conclusion of the inquiry into the conduct of the licensed officers required by law.

#### **Needed Motor-Boat Legislation.**

The dangerous conditions arising from inadequate motor-boat laws, described at length on pages 12 and 13 of my last report, continue. I then said and now repeat:

The existing conditions are a menace to the lives of innocent and unsuspecting passengers and should not be permitted to continue.

Legislation is pending which the Department has approved and which has the support also of large motor-boat interests providing for the numbering and recording of undocumented vessels, for the licensing of operators of motor vessels after a written examination, and for a certificate of approval from the local inspectors of steam vessels, for all motor boats carrying 20 passengers or more for hire. These measures, if enacted, will do much to correct abuses in the use of motor boats. Reference is made to page 20 of the report of the Commissioner of Navigation for 1917 (p. 1010 of this compilation) and to the part of this report under "Bureau of Navigation."

#### **Government-Owned Commerce Building and Laboratory-Aquarium.**

The lease of the Commerce Building expires on August 31, 1918. The annual rental is \$65,500, which represents an income of 3 per cent on \$2,183,333. All the bureaus of the Department except the Bureau of Standards should be housed in one Govern-

ment building. The land for a new Commerce Building has long been owned by the Government. The construction of a building to house the entire Department should be undertaken as soon as possible. At the same time a laboratory-aquarium should be provided for the Bureau of Fisheries. (See Report for 1915, p. 18.) On April 2, 1917, the following letter was written by me to the Speaker of the House of Representatives on this subject:

In several annual reports I have called attention to the need of a proper building for the important work of the Bureau of Fisheries. Permit me now to bring this matter again formally to your attention.

The building occupied by the Bureau of Fisheries was constructed as an armory for the District of Columbia Militia in 1856. In 1874 the engineer officer in charge of public buildings and grounds declared it to be "old and unsightly" and in his report for that year he asked authority for its condemnation and sale. In 1877 it was fitted up for the storage of specimens donated to the National Museum by exhibitors at the Centennial Exposition, although the report of the Secretary of the Smithsonian Institution for 1876 pointed out that it was ill adapted to that use on account of its inflammable character. About 1882 and for several years thereafter it was occupied, in part, as a fish hatchery, and in 1889 it was altered and refitted to serve as offices for the United States Fish Commission, to be occupied jointly with the National Museum.

After the Ford's Theater disaster, an examination of the building disclosed that it was in a condition hazardous to the lives of its occupants and in 1893 it was repaired at an expense of \$9,100. Since then it has been occupied solely by this Bureau, and nothing has been expended on it except for maintenance and makeshift rearrangements in the attempt to provide for the growing needs of the Bureau. For a number of years both the proper discharge of administrative functions, and the performance of the constructive work which is the Bureau's reason for being, have been seriously hampered by the inadequacy of the accommodations.

As the improvement of fish culture and the fisheries and the increase of the food supply are the prime functions of the Bureau, it is proper that their requirements should be given first consideration. The most pressing need is for laboratory and aquarium facilities, the two being interrelated parts of one essential instrument. A properly equipped laboratory aquarium would enable the Bureau to conduct investigations and experiments in productive fields now wholly or practically neglected for lack of facilities. The character and probable value of such researches may be indicated by a few examples.

During the past fiscal year this service collected about 4,500,000,000 eggs. The hatching of this multitude of young fish was conducted by the most approved methods available, but it is known that they are far from being the best attainable. The mortality among the eggs from unknown causes is heavy. In respect to some species of fishes this loss is normal to the present methods of fish culture, and the occurrence of obscure diseases in other species produces sporadic losses which reach a high annual aggregate. There is no doubt that experiments conducted with an adequate equipment would result in a material reduction of these occurrences. This means more food for our people.

The Bureau carries at most of its fresh-water hatcheries considerable numbers of adult brood fish, which must be fed. It is also increasing each year the number of young fish reared to the large fingerling stages, in which they can be planted with greater assurance of their ability to escape their numerous enemies, and the problem of feeding these is important. All present practices are based on empiricism, and it is believed that studies of the underlying principles, like those which have placed



cattle feeding on a sound basis, will result not only in a saving of labor and expense, but will enable the Bureau to plant fish better able to cope with their environments. This also means more and cheaper food for our people.

Nothing has been done toward improvement of the races of fishes in respect to size, vigor, rapidity of growth, and edible qualities. It is certain that the culture of fish in ponds on farms will assume importance within the next few years and the farmer should have at his command the best brood stock obtainable and information in regard to its handling and improvement at least equal in reliability to that which he can now obtain respecting poultry. The improvement of the quality and vigor of the fish planted in the public waters is equally important. This means more and better food for our people.

The Fisheries Service recently has conducted propaganda to encourage the use of previously unknown, wasted, or neglected fishery products as a result of which, millions of pounds of food have been added to the Nation's supply, and other products have entered into economic use. The possibilities of this work are practically limitless. Careful investigations have been made into all the new foods thus far introduced and it would be possible largely to increase the food supply from new and unused aquatic resources. This, however, in the interest of the public as well as of the fisheries, requires searching investigation to determine the wholesomeness of the foods and the utility of other materials from aquatic sources. For this work a laboratory is urgently needed. With it new sources of supply not only for food but for leather and many other purposes could be found. The possibilities are known and with an adequately equipped laboratory aquarium all of these potentially productive fields of work, and many more which it is not necessary to mention, could be developed. Without such facilities the Bureau has about reached its limit of usefulness in some of its most productive and most promising fields of service to the country.

For precisely the same reason that agricultural experiment stations are provided and with the same justification and for a like purpose, a laboratory aquarium should be supplied as promptly as possible to the Fisheries Service.

An incidental, but nevertheless highly important, consideration is that the aquarium would have great economic and educational value in informing the public concerning fishes and the fisheries. Many of the mistakes in local legislation and maladministration which have resulted in the ruin of some of our most valuable fisheries have been due to the ignorance respecting aquatic life and the conditions under which it exists, and the recent awakening to the necessity for fisheries conservation in New York is said to be due in no small part to the interest which has been excited among the people by the aquarium in that city. The laboratory-aquarium would pay its way. It is not an expense but a productive investment.

New York, Philadelphia, Boston, and Detroit each have a municipal aquarium and there is one of a quasi public character in Chicago, operated in a large mercantile establishment pending the completion of plans for one to be maintained by the city.

The Nation has recognized its obligation to the cause of education by the establishment of the National Museum and the National Zoological Park in this city, and it appears reasonable to urge that a National Aquarium, with not only an educational but a direct economic appeal, has even greater value.

### **Archives Building Needed.**

As time goes on, the construction of an archives building which should provide proper safeguards for the invaluable records of the Government becomes of greater importance. The records of the Coast and Geodetic Survey are of priceless value. It would be impossible to replace them if they were burned. The scientific

records of the Bureau of Fisheries, the statistical records of the Bureau of the Census from the beginning of the Government to the present time, the records of shipping in the Bureau of Navigation, are all exposed to loss and damage. These records are in constant use. They are of sufficient bulk to require 85,000 cubic feet of space in the proposed archives building. There is no argument in favor of the existence of the Library of Congress that does not apply to the establishment of our Government records in a building which shall serve for them the same purpose that the Library of Congress does. Not long ago, in a village of but a few hundred people, I saw a brick building, fireproof and separate from all others, bearing the title above the door "Village records." One could not but feel how much wiser the authorities of that hamlet were than the Government of the United States has been in the same connection.

Under the head "Coast and Geodetic Survey," the needs of that Service for a proper building are again pointed out.

#### **Urgent Needs of Department Summarized.**

Among the urgent needs of the Department are the following:

*Personnel.*—1. Provision for adequate salaries and for promotions in the Bureau of the Census.

2. Adequate salaries for the lighthouse inspectors and a retirement system for the field force.

3. Adequate wages for seamen and sea officers in three services

4. More commercial attachés abroad and proper provision for their clerks.

5. Greater clerical force in the field service of the Steamboat-Inspection Service and in the office of the Coast and Geodetic Survey.

*Equipment.*—1. A building at the Bureau of Standards for investigations into structural materials.

2. New vessels and wire-drag launches for the Coast and Geodetic Survey.

3. A laboratory-aquarium for the Bureau of Fisheries.

4. A Government-owned Commerce Building to house all the services except the Bureau of Standards and the laboratory-aquarium, failing which there should be provided an adequate building for the Coast and Geodetic Survey.

5. If the above are not provided, some adequate means for safeguarding the public records against loss by fire.

6. A power lighter for the use of the Bureau of Fisheries in loading and unloading vessels at the Pribilof Islands and for communication between the islands.

### Cost of Enforcing Navigation Laws.

The following table shows for a period of six years the outlay for the Bureau of Navigation in enforcing the navigation laws by its own two motor vessels, the *Tarragon* and the *Dixie*. It includes the original cost of the vessels as well as their maintenance, and shows the receipts derived from mitigated fines imposed for violations discovered by these vessels.

	Original cost.	Maintenance.						Total.
		1912	1913	1914	1915	1916	1917	
Tarragon.....	a \$4,500	\$1,316.62	\$9,022.77	\$11,335.76	\$7,597.13	\$5,113.26	\$9,894.54	\$48,780.08
Dixie.....	b 9,000				1,780.84	16,915.94	13,034.64	40,731.42
Total.....	13,500	1,316.62	9,022.77	11,335.76	9,377.97	22,029.20	22,929.18	89,511.50
Collections from navigation fines.....		31,578.13	31,987.85	47,162.02	41,518.24	52,381.75	49,962.37	254,590.36

a April, 1912.

b April, 1915.

This is a remarkable showing. As against a total outlay, including the purchase price of the vessels, repairs, and operation complete, of \$89,511.50 for six years, the receipts have been \$254,590.36. The entire cost of maintaining the Bureau of Navigation for the fiscal year 1917 was \$201,330. The receipts under its supervision from tonnage dues, navigation fees, and fines for violations aggregate \$1,603,489.32, or nearly eight times the cost of the service.

### Balance of Trade in Favor of United States.

The visible balance of trade in favor of the United States on merchandise transactions for the fiscal year ended June 30, 1917, was \$3,634,450,905. The total of our merchandise export trade was \$6,293,806,090 and of our import trade \$2,659,355,185. During the three months' period from the close of the fiscal year to October 1, the merchandise exports have been \$1,319,213,625, the imports \$729,978,017, and the net visible balance \$589,235,608.

### Uniform Contracts and Cost Accounting Definitions and Methods.

The Bureau of Foreign and Domestic Commerce has rendered a public service of unusual merit in the preparation and publication in July, 1917, of the pamphlet entitled "Uniform Contracts and

Cost Accounting Definitions and Methods." This was prepared by an interdepartmental conference comprising representatives from the War and Navy Departments, the Federal Trade Commission, the Council of National Defense, the War Industries Board, the Institute for Government Research, and the Department of Commerce. Its recommendations have found wide acceptance and its clear definitions of costs and methods, with its suggested standard contract forms, have been of great value.

#### **Development of New Fish Foods.**

Special attention is directed to the successful work of the Bureau of Fisheries in the development of new foods.

#### **Appropriations and Expenditures.**

The itemized statement of the disbursements from the contingent fund of the Department of Commerce and the appropriation for "General expenses, Bureau of Standards," for the fiscal year ended June 30, 1917, required to be submitted to Congress by section 193 of the Revised Statutes of the United States; the itemized statement of expenditures under all appropriations for propagation of food fishes during the fiscal year ended June 30, 1917, required by the act of Congress approved March 3, 1887 (24 Stat., 523); and a statement showing travel on official business by officers and employees (other than the special agents, inspectors, and employees who, in the discharge of their regular duties, are required to travel constantly) from Washington to points outside of the District of Columbia during the fiscal year ended June 30, 1917, as required by the act of Congress approved May 22, 1908 (35 Stat., 244), will be transmitted to Congress in the usual form.

The table following shows the total amounts of all appropriations for the various bureaus and services of the Department of Commerce for the fiscal year ended June 30, 1917.

Bureau.	Legislative act.	Sundry civil act.	Deficiency act.	Special act.	Total.
Office of the Secretary .....	\$302,840.00		\$0.92		\$302,840.92
Bureau of Lighthouses .....	64,030.00	\$5,849,000.00	126,182.33	\$320.00	6,039,532.33
Bureau of the Census .....	1,210,460.00			160.00	1,210,620.00
Bureau of Foreign and Domestic Commerce .....	505,640.00		150,000.00		655,640.00
Steamboat-Inspection Service .....	612,540.00		19,404.50		631,944.50
Bureau of Navigation .....	207,330.00			9,073.35	216,403.35
Bureau of Standards .....	706,220.00	90,000.00	510,157.35	720.00	1,307,097.35
Bureau of Fisheries .....		1,139,850.00	10,024.38	25,000.00	1,174,874.38
Coast and Geodetic Survey .....		1,227,140.00	51,456.54		1,278,596.54
Total .....	3,603,060.00	8,305,990.00	867,226.02	35,273.35	12,811,549.37
Allotment for printing and binding .....		400,000.00			400,000.00
Grand total .....	3,603,060.00	8,705,990.00	867,226.02	35,273.35	13,211,549.37

The disbursements by the authorized disbursing officers of the Department of Commerce during the fiscal year ended June 30, 1917, arranged according to items of appropriation, are as follows:

*By Disbursing Clerk, Department of Commerce.*

OFFICE OF THE SECRETARY.

Salaries, Office of Secretary of Commerce, 1916 .....	\$7,086.83
Salaries, Office of Secretary of Commerce, 1917 .....	169,777.18
Contingent expenses, Department of Commerce, 1915 .....	129.91
Contingent expenses, Department of Commerce, 1916 .....	18,311.85
Contingent expenses, Department of Commerce, 1917 .....	83,675.80
Rent, Department of Commerce, 1916 .....	5,708.34
Rent, Department of Commerce, 1917 .....	60,541.66
Total .....	345,231.57

BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

Salaries, Bureau of Foreign and Domestic Commerce, 1916 .....	4,970.19
Salaries, Bureau of Foreign and Domestic Commerce, 1917 .....	121,352.43
Promoting commerce, Department of Commerce, 1915 .....	90.57
Promoting commerce, Department of Commerce, 1916 .....	4,949.84
Promoting commerce, Department of Commerce, 1917 .....	62,800.66
Promoting commerce, South and Central America, 1916 .....	3,522.09
Promoting commerce, South and Central America, 1917 .....	26,883.01
Investigating cost of production, Department of Commerce, 1916 .....	1,686.56
Investigating cost of production, Department of Commerce, 1917 .....	31,224.70
Commercial attachés, Department of Commerce, 1916 .....	4,100.94
Commercial attachés, Department of Commerce, 1917 .....	3,019.81
Total .....	264,600.80

## BUREAU OF STANDARDS.

Salaries, Bureau of Standards, 1916.....	\$11,608.96
Salaries, Bureau of Standards, 1917.....	277,480.81
Equipment, Bureau of Standards, 1915.....	163.79
Equipment, Bureau of Standards, 1916.....	19,305.98
Equipment, Bureau of Standards, 1917.....	32,974.34
General expenses, Bureau of Standards, 1915.....	914.29
General expenses, Bureau of Standards, 1916.....	4,327.29
General expenses, Bureau of Standards, 1917.....	17,142.07
Testing structural materials, Bureau of Standards, 1915.....	56.18
Testing structural materials, Bureau of Standards, 1916.....	6,667.30
Testing structural materials, Bureau of Standards, 1917.....	88,529.02
Improvement and care of grounds, Bureau of Standards, 1916.....	783.40
Improvement and care of grounds, Bureau of Standards, 1917.....	2,803.62
Investigation of fire-resisting properties, Bureau of Standards, 1915...	12.80
Investigation of fire-resisting properties, Bureau of Standards, 1916...	3,594.40
Investigation of fire-resisting properties, Bureau of Standards, 1917...	18,355.12
Testing machines, Bureau of Standards, 1916.....	1,107.15
Testing machines, Bureau of Standards, 1917.....	25,104.38
Testing railroad scales, etc., Bureau of Standards, 1915.....	1,000.00
Testing railroad scales, etc., Bureau of Standards, 1916.....	3,598.75
Testing railroad scales, etc., Bureau of Standards, 1917.....	31,588.53
Investigation of public-utility standards, Bureau of Standards, 1915..	296.67
Investigation of public-utility standards, Bureau of Standards, 1916..	1,898.68
Investigation of public-utility standards, Bureau of Standards, 1917..	38,144.78
High-potential investigations, Bureau of Standards, 1916.....	1,115.73
High-potential investigations, Bureau of Standards, 1917.....	13,825.06
Investigation of railway materials, Bureau of Standards, 1916.....	3,014.15
Investigation of railway materials, Bureau of Standards, 1917.....	12,627.86
Refrigeration constants, Bureau of Standards, 1916.....	1,010.80
Refrigeration constants, Bureau of Standards, 1917.....	14,394.70
Testing miscellaneous materials, Bureau of Standards, 1915.....	10.94
Testing miscellaneous materials, Bureau of Standards, 1916.....	2,600.90
Testing miscellaneous materials, Bureau of Standards, 1917.....	17,755.23
Radio research, Bureau of Standards, 1916.....	4,107.25
Radio research, Bureau of Standards, 1917.....	12,848.11
Heating system, North Laboratory, Bureau of Standards, 1916.....	425.19
Equipping Chemical Laboratory Building, Bureau of Standards, 1916-17.....	11,324.47
Investigation of clay products, Bureau of Standards, 1917.....	9,212.13
Determining physical constants, Bureau of Standards, 1917.....	2,932.50
Color standardization, Bureau of Standards, 1917.....	6,661.30
Standardizing mechanical appliances, Bureau of Standards, 1917.....	2,704.59
Radio Laboratory, Bureau of Standards.....	1,334.76
Chemical Laboratory, Bureau of Standards.....	84,544.97
Workshop and storehouse, Bureau of Standards.....	139.61
Total.....	<u>790,057.56</u>

## STEAMBOAT-INSPECTION SERVICE.

Salaries, Office of Supervising Inspector General, Steamboat-Inspection Service, 1916.....	\$647. 53
Salaries, Office of Supervising Inspector General, Steamboat-Inspection Service, 1917.....	15, 736. 00
Salaries, Steamboat-Inspection Service, 1916.....	29, 921. 21
Salaries, Steamboat-Inspection Service, 1917.....	374, 299. 02
Clerk hire, Steamboat-Inspection Service, 1916.....	7, 000. 08
Clerk hire, Steamboat-Inspection Service, 1917.....	76, 256. 74
Contingent expenses, Steamboat-Inspection Service, 1915.....	1. 36
Contingent expenses, Steamboat-Inspection Service, 1916.....	11, 653. 76
Contingent expenses, Steamboat-Inspection Service, 1917.....	90, 048. 59
Total.....	<u>605, 564. 29</u>

## BUREAU OF NAVIGATION.

Salaries, Bureau of Navigation, 1916.....	1, 386. 71
Salaries, Bureau of Navigation, 1917.....	35, 882. 73
Salaries, Shipping Service, 1916.....	2, 393. 52
Salaries, Shipping Service, 1917.....	25, 466. 56
Clerk hire, Shipping Service, 1916.....	3, 384. 04
Clerk hire, Shipping Service, 1917.....	35, 128. 96
Contingent expenses, Shipping Service, 1916.....	743. 16
Contingent expenses, Shipping Service, 1917.....	4, 903. 06
Preventing overcrowding of passenger vessels, 1916.....	692. 43
Preventing overcrowding of passenger vessels, 1917.....	14, 790. 96
Enforcement of navigation laws, 1916.....	1, 006. 31
Enforcement of navigation laws, 1917.....	22, 930. 60
Enforcement of wireless-communication laws, 1916.....	2, 071. 57
Enforcement of wireless-communication laws, 1917.....	36, 651. 69
Admeasurement of vessels, 1916.....	138. 59
Admeasurement of vessels, 1917.....	2, 246. 79
Total.....	<u>189, 817. 68</u>

## BUREAU OF FISHERIES.

Salaries, Bureau of Fisheries, 1916.....	26, 491. 52
Salaries, Bureau of Fisheries, 1917.....	360, 861. 30
Miscellaneous expenses, Bureau of Fisheries, 1915.....	67. 82
Miscellaneous expenses, Bureau of Fisheries, 1915-16.....	2, 556. 90
Miscellaneous expenses, Bureau of Fisheries, 1916.....	44, 887. 24
Miscellaneous expenses, Bureau of Fisheries, 1917.....	404, 168. 23
Protecting seal and salmon fisheries of Alaska, 1915.....	4. 29
Protecting seal and salmon fisheries of Alaska, 1916.....	4, 483. 32
Protecting seal and salmon fisheries of Alaska, 1917.....	71, 244. 96
Marine biological station, Florida.....	3, 764. 84
Distribution cars, Bureau of Fisheries, 1915-16.....	807. 00
Payment to Great Britain and Japan under Article XI of Fur-Seals Convention of 1911.....	20, 000. 00
Vessels, fish hatchery, Boothbay Harbor, Me., 1915-16.....	39, 795. 30
Investigating damages to fisheries.....	9, 330. 06
Buildings and improvements, fur-seal islands, Alaska.....	261. 20
Lobster-rearing plant, Bureau of Fisheries.....	39. 85
Motor launches, Alaska fisheries service, 1917.....	9, 468. 90
Cold-storage plant, fur-seal islands, Alaska, 1915-16.....	2, 396. 64

**Fish hatcheries:**

Cape Vincent, N. Y.....	\$85. 10
Clackamas, Oreg.....	11, 581. 29
Duluth, Minn.....	1, 999. 74
Gloucester, Mass., 1917.....	18. 15
Kentucky.....	4, 076. 67
Puget Sound, Wash.....	2, 531. 09
South Carolina.....	531. 45
Upper Mississippi River Valley.....	82. 68
Utah.....	25, 639. 16
Woods Hole, Mass., 1915.....	16, 903. 74
Wyoming.....	1, 198. 95
<b>Total.....</b>	<b>1, 065, 277. 39</b>

**BUREAU OF THE CENSUS.**

Salaries, Bureau of the Census, 1916.....	27, 740. 64
Salaries, Bureau of the Census, 1917.....	631, 031. 58
Collecting statistics, Bureau of the Census, 1915.....	101. 55
Collecting statistics, Bureau of the Census, 1915-16.....	1, 406. 96
Collecting statistics, Bureau of the Census, 1916.....	8, 723. 08
Collecting statistics, Bureau of the Census, 1917.....	371, 171. 42
Tabulating machines, Bureau of the Census, 1916.....	1, 981. 64
Tabulating machines, Bureau of the Census, 1917.....	19, 298. 56
<b>Total.....</b>	<b>1, 061, 454. 83</b>

**BUREAU OF LIGHTHOUSES.**

Salaries, Bureau of Lighthouses, 1916.....	2, 834. 65
Salaries, Bureau of Lighthouses, 1917.....	58, 778. 22
Salaries, Lighthouse Service, 1916.....	193. 75
Salaries, Lighthouse Service, 1917.....	6, 206. 25
Salaries, lighthouse vessels, 1917.....	759. 52
Salaries, keepers of lighthouses, 1916.....	43. 70
Salaries, keepers of lighthouses, 1917.....	38. 13
General expenses, Lighthouse Service, 1915.....	69. 07
General expenses, Lighthouse Service, 1916.....	13, 034. 83
General expenses, Lighthouse Service, 1917.....	28, 657. 09
<b>Aids to navigation:</b>	
Alaska.....	35. 07
Atchafalaya Entrance, La.....	105. 25
Ashtabula Harbor, Ohio.....	63. 19
Lorain Harbor, Ohio.....	72. 25
St. Johns River, Fla.....	67. 74
Cape Cod Canal Lights, Mass.....	82. 28
Fort McHenry Channel Range Lights, Md.....	84. 94
Cape St. Elias Light Station, Alaska.....	1, 482. 20
Navassa Island Light Station, West Indies.....	48, 446. 27
Hunts Point Light Station, N. Y.....	3. 15
Tender for first lighthouse district.....	50, 532. 88
Tender for engineer, sixth lighthouse district.....	19, 307. 56
Lighthouse tender for general service.....	70, 839. 71
Light vessels for general service.....	56, 872. 28
Lighting Norfolk Harbor, Va.....	150. 36
Southwest Pass Light Vessel, Mississippi River, La.....	39, 408. 73



Repairing and rebuilding aids to navigation, Gulf of Mexico .....	\$255. 78
Cleveland fog-signal station, Ohio .....	1. 73
Oil houses for light stations .....	15. 96
<b>Total</b> .....	<b>398, 442. 54</b>
<b>Grand total</b> .....	<b>4, 720, 446. 66</b>

*By disbursing officers of the Lighthouse Service.*

Salaries, Lighthouse Service, 1916 .....	\$3, 602. 83
Salaries, Lighthouse Service, 1917 .....	357, 851. 81
Salaries, lighthouse vessels, 1916 .....	31, 115. 26
Salaries, lighthouse vessels, 1917 .....	1, 007, 560. 61
Salaries, keepers of lighthouses, 1916 .....	23, 492. 44
Salaries, keepers of lighthouses, 1917 .....	903, 605. 09
General expenses, Lighthouse Service, 1915 .....	20, 063. 68
General expenses, Lighthouse Service, 1916 .....	419, 458. 67
General expenses, Lighthouse Service, 1917 .....	2, 276, 987. 14
<b>Aids to navigation:</b>	
Alaska .....	2, 157. 90
Ashtabula Harbor, Ohio .....	10, 791. 89
Atchafalaya Entrance, La. ....	12, 825. 19
Conneaut Harbor, Ohio .....	704. 43
Coquille River, Oreg. ....	36. 34
Delaware River, Pa. and Del. ....	14, 498. 46
Fighting Island Channel, Mich. ....	8, 399. 25
Florida Reefs, Fla. ....	1, 127. 00
Hudson River, N. Y. ....	40. 66
Lorain Harbor, Ohio .....	27, 268. 12
Manistique, Mich. ....	1, 149. 61
Mississippi River, La. ....	567. 57
Puget Sound, Wash. ....	4, 478. 24
St. Johns River, Fla. ....	12, 338. 76
Toledo Harbor, Ohio .....	143. 00
Cape Cod Canal Lights, Mass. ....	2, 008. 75
Detroit River Lights, Mich. ....	865. 23
Fort McHenry Channel Range Lights, Md. ....	238. 97
Newark Bay Beacon Lights, N. J. ....	1, 538. 38
Superior Pierhead Range Lights, Wis. ....	124. 58
Cape St. Elias Light Station, Alaska. ....	30, 449. 89
Galveston Jetty Light Station, Tex. ....	1, 347. 34
Hunts Point Light Station, N. Y. ....	2, 791. 22
Kellett Bluff Light Station, Wash. ....	1, 258. 34
Navassa Island Light Station, West Indies. ....	5, 472. 42
Point Vincente Light Station, Cal. ....	13. 50
Thimble Shoal Light Station, Va. ....	42. 96
Tender for first lighthouse district. ....	4, 396. 55
Tender for fifteenth lighthouse district. ....	607. 01
Tender for engineer, sixth lighthouse district. ....	3, 827. 57
Lighthouse tender for general service. ....	5, 654. 70
Light vessels for general service. ....	4, 467. 81
Milwaukee Light Vessel, Wis. ....	240. 00
Southwest Pass Light Vessel, Mississippi River, La. ....	2, 700. 18
Staten Island lighthouse depot, N. Y. ....	10, 909. 55
Woods Hole lighthouse depot, Mass. ....	33, 171. 69

Depot for sixth lighthouse district.....	\$4, 697. 89
Repairing and rebuilding aids to navigation, Gulf of Mexico.....	117, 119. 41
Cleveland fog-signal station, Ohio.....	4, 296. 25
Oil houses for light stations.....	237. 37
Tender and barge, eighth lighthouse district.....	13. 14
Lighting Norfolk Harbor, Va.....	1, 386. 72

Total..... 5, 380, 141. 37

*By the special disbursing agent, Coast and Geodetic Survey.*

Salaries, Coast and Geodetic Survey, 1916.....	\$13, 238. 11
Salaries, Coast and Geodetic Survey, 1917.....	380, 516. 15
Party expenses, Coast and Geodetic Survey (no year).....	1, 281. 94
Party expenses, Coast and Geodetic Survey, 1915-16.....	6, 029. 45
Party expenses, Coast and Geodetic Survey, 1916.....	65, 149. 56
Party expenses, Coast and Geodetic Survey, 1917.....	326, 744. 54
Pay, etc., of officers and men, vessels, Coast Survey, 1915.....	268. 67
Pay, etc., of officers and men, vessels, Coast Survey, 1916.....	44, 406. 72
Pay, etc., of officers and men, vessels, Coast Survey, 1917.....	206, 674. 49
Repairs of vessels, Coast Survey, 1916.....	9, 004. 74
Repairs of vessels, Coast Survey, 1917.....	38, 835. 29
General expenses, Coast and Geodetic Survey, 1915.....	20. 65
General expenses, Coast and Geodetic Survey, 1916.....	2, 411. 95
General expenses, Coast and Geodetic Survey, 1917.....	64, 373. 36
Two new vessels, Coast Survey.....	62, 785. 77
Repairs to Coast Survey steamer <i>Explorer</i> , 1916.....	992. 99
Charts, Coast and Geodetic Survey, 1917-18.....	2, 403. 83
Outfitting Coast Survey steamer <i>Surveyor</i> , 1917.....	847. 08

Total..... 1, 225, 985. 29

*By the special disbursing agents, Bureau of Fisheries.*

Salaries, Bureau of Fisheries, 1917.....	\$4, 800. 00
Miscellaneous expenses, Bureau of Fisheries, 1917.....	11, 053. 84
Protecting seal and salmon fisheries of Alaska, 1917.....	1, 963. 00
Pay, officers and crew of vessel, Alaska fisheries service, 1917.....	15, 973. 76

Total..... 33, 790. 60

*By the commercial agents investigating trade conditions abroad, Department of Commerce, acting as special disbursing agents.*

Promoting commerce, Department of Commerce, 1916.....	\$67. 97
Promoting commerce, Department of Commerce, 1917.....	46, 624. 66
Promoting commerce, South and Central America, 1916.....	7. 00
Promoting commerce, South and Central America, 1917.....	60, 115. 68
Commercial attachés, Department of Commerce, 1915.....	324. 97
Commercial attachés, Department of Commerce, 1916.....	99. 80
Commercial attachés, Department of Commerce, 1917.....	89, 776. 17

Total..... 197, 016. 25

Warrants drawn on the Treasurer of the United States to satisfy accounts settled by the Auditor for the State and Other Departments, during the fiscal year ended June 30, 1917, classified according to items of appropriation:

Office of the Secretary:

Contingent expenses, Department of Commerce, 1916.....	\$140. 43
Contingent expenses, Department of Commerce, 1917.....	141. 36
Certified claims—Contingent expenses, Department of Commerce, 1913.....	. 92
<b>Total.....</b>	<b>282. 71</b>

Bureau of Foreign and Domestic Commerce:

Promoting commerce, Department of Commerce, 1915.....	19. 71
Promoting commerce, Department of Commerce, 1916.....	28. 71
Promoting commerce, Department of Commerce, 1917.....	55. 74
Promoting commerce, South and Central America, 1916.....	22. 51
Promoting commerce, South and Central America, 1917.....	408. 26
Commercial attachés, Department of Commerce, 1915.....	22. 11
Commercial attachés, Department of Commerce, 1916.....	64. 39
Commercial attachés, Department of Commerce, 1917.....	7. 44
<b>Total.....</b>	<b>628. 87</b>

Bureau of Standards:

Equipment, Bureau of Standards, 1916.....	49. 57
Equipment, Bureau of Standards, 1917.....	84. 63
General expenses, Bureau of Standards, 1916.....	12. 88
General expenses, Bureau of Standards, 1917.....	18. 39
Testing structural materials, Bureau of Standards, 1916.....	330. 36
Testing structural materials, Bureau of Standards, 1917.....	1, 251. 35
Testing machines, Bureau of Standards, 1917.....	179. 83
Investigation of fire-resisting properties, Bureau of Standards, 1916.....	144. 45
Testing railroad scales, etc., Bureau of Standards, 1916.....	166. 84
Testing railroad scales, etc., Bureau of Standards, 1917.....	374. 44
Investigation of railway materials, Bureau of Standards, 1916.....	35. 65
Investigation of railway materials, Bureau of Standards, 1917.....	32. 88
Relief of William A. Hutson for injuries.....	720. 00
Certified claims—	
General expenses, Bureau of Standards, 1914.....	139. 64
Testing structural materials, Bureau of Standards, 1913.....	17. 71
<b>Total.....</b>	<b>3, 558. 62</b>

Steamboat-Inspection Service:

Contingent expenses, Steamboat-Inspection Service, 1915.....	. 56
Contingent expenses, Steamboat-Inspection Service, 1916.....	184. 49
Contingent expenses, Steamboat-Inspection Service, 1917.....	313. 50
Certified claims—Contingent expenses, Steamboat-Inspection Service, 1912.....	4. 50
<b>Total.....</b>	<b>503. 05</b>

**Bureau of Navigation:**

Contingent expenses, Shipping Service, 1916.....	\$1. 32
Enforcement of wireless-communication laws, 1915.....	1. 21
Enforcement of wireless-communication laws, 1916.....	9. 50
Refunding penalties or charges erroneously exacted.....	5, 581. 51
Refund of tonnage taxes and light dues to citizens of Philippine Islands.....	3, 562. 04
<b>Total.....</b>	<b>9, 155. 58</b>

**Bureau of Fisheries:**

Miscellaneous expenses, Bureau of Fisheries, 1915.....	3. 29
Miscellaneous expenses, Bureau of Fisheries, 1915-16.....	425. 86
Miscellaneous expenses, Bureau of Fisheries, 1916.....	4, 662. 61
Miscellaneous expenses, Bureau of Fisheries, 1917.....	8, 783. 30
Protecting seal and salmon fisheries of Alaska, 1916.....	9, 561. 33
Protecting seal and salmon fisheries of Alaska, 1917.....	55. 64
Fish hatchery, South Carolina.....	1. 47
Fish hatchery, Wyoming.....	55. 60
<b>Certified claims—</b>	
Miscellaneous expenses, Bureau of Fisheries, 1910.....	4. 79
Miscellaneous expenses, Bureau of Fisheries, 1912.....	4. 59
Miscellaneous expenses, Bureau of Fisheries, 1913.....	15. 00
<b>Total.....</b>	<b>23, 573. 48</b>

**Bureau of the Census:**

Relief of Wallace L. Bell.....	160. 00
Relief of Alice V. Houghton for injuries.....	900. 00
<b>Total.....</b>	<b>1, 060. 00</b>

**Coast and Geodetic Survey:**

Party expenses, Coast and Geodetic Survey, 1915-16.....	920. 58
Party expenses, Coast and Geodetic Survey, 1916.....	3, 207. 67
Party expenses, Coast and Geodetic Survey, 1917.....	5, 287. 41
Repairs of vessels, Coast Survey, 1916.....	390. 14
Repairs of vessels, Coast Survey, 1917.....	4, 563. 83
General expenses, Coast and Geodetic Survey, 1916.....	46. 14
General expenses, Coast and Geodetic Survey, 1917.....	1, 018. 11
Two new vessels, Coast Survey.....	1, 627. 41
<b>Certified claims—</b>	
Party expenses, Coast and Geodetic Survey, 1913.....	3. 09
Party expenses, Coast and Geodetic Survey, 1914.....	. 45
<b>Total.....</b>	<b>17, 064. 83</b>

**Bureau of Lighthouses:**

Salaries, lighthouse vessels, 1916.....	620. 83
Salaries, lighthouse vessels, 1917.....	2, 483. 43
Salaries, keepers of lighthouses, 1916.....	261. 50
General expenses, Lighthouse Service, 1915.....	2, 500. 14
General expenses, Lighthouse Service, 1916.....	68, 915. 19
General expenses, Lighthouse Service, 1917.....	66, 530. 42
<b>Aids to navigation—</b>	
Alaska.....	973. 64
Atchafalaya Entrance, La.....	90. 89
Delaware River, Pa. and Del.....	100. 60
Puget Sound, Wash.....	460. 95

**Bureau of Lighthouses—Continued.**

Navassa Island Light Station, West Indies.....	\$43.31
Tender for first lighthouse district.....	70.00
Tender for fifteenth lighthouse district.....	71.79
Lighthouse tender for general service.....	211.15
Cape Cod Canal Lights, Mass.....	34.25
Fort McHenry Channel Range Lights, Md.....	122.86
Southwest Pass Light Vessel, Mississippi River, La.....	2.89
Light vessels for general service.....	2.74
Repairing and rebuilding aids to navigation, Gulf of Mexico.....	244.40
Cleveland fog-signal station, Ohio.....	1.85
Claims for damages by collision with lighthouse vessels.....	56.88
Relief of estate of William D. Allen.....	320.00
<b>Certified claims—</b>	
Salaries, keepers of lighthouses, 1910.....	23.25
Salaries, keepers of lighthouses, 1913.....	487.34
General expenses, Lighthouse Service, 1912.....	1.10
General expenses, Lighthouse Service, 1913.....	382.10
General expenses, Lighthouse Service, 1914.....	8.16
Supplies of lighthouses, 1906.....	38.65
Supplies of lighthouses, 1907.....	23.19
Expenses of light vessels, 1906.....	15.46
Expenses of light vessels, 1907.....	9.02
Expenses of buoyage, 1906.....	15.46
Expenses of buoyage, 1907.....	9.01
Expenses of buoyage, 1911.....	21.17
Lighting of rivers, 1906.....	7.73
Lighting of rivers, 1907.....	5.16
Lincoln Rock Light Station, Nebr.....	6.48
Tender for inspector, eighth lighthouse district.....	2.16
Oconto Harbor Lights, Wis.....	70.01

Total.....	<u>145,245.16</u>
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Miscellaneous: Judgments, Court of Claims, Department of Commerce..	<u>500.00</u>
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Grand total.....	<u>201,572.30</u>
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The following statement shows the expenditures during the fiscal year ended June 30, 1917, on account of all appropriations under the control of the Department, giving the total amounts disbursed by the various disbursing officers of the Department, and miscellaneous receipts for the same period:

**EXPENDITURES.**

By the Disbursing Clerk, Department of Commerce, on account of salaries and expenses of the Office of the Secretary of Commerce, the Bureau of Foreign and Domestic Commerce, Navigation, Standards, Fisheries, Census, and Lighthouses, the Office of the Supervising Inspector General, Steamboat-Inspection Service, salaries and expenses of Steamboat-Inspection Service at large, and public works of the Lighthouse and Fisheries Services (shown in detail in the first of the foregoing tables of disbursements).....	\$4,720,446.66
By the authorized disbursing officers of the Lighthouse Service.....	5,380,141.37

By the special disbursing agent, Coast and Geodetic Survey, on account of salaries and expenses of the Coast and Geodetic Survey.....	\$1, 225, 985. 29
By special disbursing agents, Bureau of Fisheries.....	33, 790. 60
By the commercial agents of the Department investigating trade conditions abroad, as special disbursing agents.....	197, 016. 25
By warrants drawn on the Treasurer of the United States to satisfy accounts settled by the Auditor for the State and Other Departments.....	201, 572. 30
Printing and binding.....	382, 602. 76
<b>Total.....</b>	<b>12, 141, 555. 23</b>

## MISCELLANEOUS RECEIPTS.

Coast and Geodetic Survey: Sale of charts, publications, old property, etc.....	20, 923. 46
Bureau of the Census: Sale of publications, etc.....	413. 00
Bureau of Fisheries:	
Sale of 1, 500 sealskins.....	48, 005. 46
Sale of fox and other skins.....	135, 925. 85
Sale of old property, etc.....	6, 052. 55
Bureau of Navigation:	
Tonnage tax.....	1, 393, 743. 16
Navigation fees.....	159, 812. 53
Navigation fines.....	49, 962. 37
From deceased passengers.....	260. 00
Sale of old property.....	2. 92
Bureau of Standards:	
Sale of Government property, etc.....	35. 12
Standardizing and testing weights.....	11, 678. 52
Steamboat-Inspection Service: Sale of condemned property, etc.....	116. 89
Bureau of Lighthouses: Sale of public property, rentals, etc.....	20, 669. 59
Office of the Secretary: Sale of condemned property, etc.....	97. 75
<b>Total.....</b>	<b>1, 847, 699. 17</b>

The following unexpended balances of appropriations were turned into the surplus fund June 30, 1917, in accordance with the act of June 20, 1874 (18 Stat., 110-111):

Office of the Secretary:	
Salaries, Office of Secretary of Commerce, 1915.....	\$1, 166. 73
Contingent expenses, Department of Commerce, 1912.....	3. 50
Contingent expenses, Department of Commerce, 1915.....	1, 262. 08
Rent, Department of Commerce, 1915.....	600. 04
Bureau of the Census:	
Salaries, Bureau of the Census, 1915.....	16, 658. 31
Collecting statistics, Bureau of the Census, 1915.....	44. 23
Tabulating machines, Bureau of the Census, 1915.....	177. 18
Bureau of Foreign and Domestic Commerce:	
Salaries, Bureau of Foreign and Domestic Commerce, 1915.....	2, 060. 25
Collating tariffs of foreign countries, 1915.....	12. 51
Commercial attachés, Department of Commerce, 1915.....	13, 982. 58
Promoting commerce, Department of Commerce, 1915.....	1, 550. 45
Promoting commerce, South and Central America, 1915.....	2, 320. 38
Investigating cost of production, Department of Commerce, 1915...	1, 450. 69

## Steamboat-Inspection Service:

Salaries, Office of Supervising Inspector General, Steamboat-Inspection Service, 1915.....	\$71. 03
Salaries, Steamboat-Inspection Service, 1915.....	2, 116. 38
Clerk hire, Steamboat-Inspection Service, 1915.....	236. 77
Contingent expenses, Steamboat-Inspection Service, 1915.....	2, 963. 04

## Bureau of Navigation:

Salaries, Bureau of Navigation, 1915.....	154. 90
Salaries, Shipping Service, 1915.....	687. 02
Clerk hire, Shipping Service, 1915.....	57. 51
Contingent expenses, Shipping Service, 1915.....	9. 08
Instruments for counting passengers, 1915.....	13. 40
Admeasurement of vessels, 1915.....	44. 39
Preventing overcrowding of passenger vessels, 1915.....	2, 712. 38
Enforcement of navigation laws, 1915.....	10. 42
Enforcement of wireless-communication laws, 1915.....	35. 79

## Bureau of Standards:

Salaries, Bureau of Standards, 1915.....	15, 014. 17
Equipment, Bureau of Standards, 1915.....	2, 113. 19
General expenses, Bureau of Standards, 1915.....	1, 125. 24
Improvement and care of grounds, Bureau of Standards, 1915.....	1. 26
Investigation of fire-resisting properties, Bureau of Standards, 1915..	349. 63
High potential investigations, Bureau of Standards, 1915.....	15. 04
Investigation of public-utility standards, Bureau of Standards, 1915..	1, 769. 69
Investigation of railway materials, Bureau of Standards, 1915.....	160. 94
Refrigeration constants, Bureau of Standards, 1915.....	2. 11
Testing machines, Bureau of Standards, 1915.....	146. 85
Testing miscellaneous materials, Bureau of Standards, 1915.....	79. 36
Testing railroad scales, etc., Bureau of Standards, 1915.....	178. 93
Testing structural materials, Bureau of Standards, 1915.....	240. 32

## Coast and Geodetic Survey:

Salaries, Coast and Geodetic Survey, 1915.....	2, 005. 12
Party expenses, Coast and Geodetic Survey, 1915.....	2, 242. 60
General expenses, Coast and Geodetic Survey, 1915.....	537. 83
Buildings, Coast and Geodetic Survey, 1915.....	51. 66
Pay, etc., of officers and men, vessels, Coast Survey, 1907.....	1. 74
Pay, etc., of officers and men, vessels, Coast Survey, 1915.....	1, 995. 16
Repairs of vessels, Coast Survey, 1915.....	2, 185. 28

## Bureau of Lighthouses:

Salaries, Bureau of Lighthouses, 1915.....	819. 89
General expenses, Lighthouse Service, 1914.....	153. 00
General expenses, Lighthouse Service, 1915.....	12, 145. 44
Salaries, keepers of lighthouses, 1915.....	26, 040. 96
Salaries, lighthouse vessels, 1915.....	6, 350. 48
Salaries, Lighthouse Service, 1915.....	11, 120. 52
Rondout Creek Light Station, N. Y.....	6, 424. 19
Fort McHenry Channel Range Lights, Md.....	295. 19
Milwaukee Light Vessel, Wis.....	459. 73
Aids to navigation, Manistique, Mich.....	. 04
Tender for fifteenth lighthouse district.....	276. 72

## Bureau of Fisheries:

Salaries, Bureau of Fisheries, 1915.....	18, 894. 92
Miscellaneous expenses, Bureau of Fisheries, 1915.....	3, 554. 91
Protecting seal and salmon fisheries of Alaska, 1914-1915.....	88. 03
Protecting seal and salmon fisheries of Alaska, 1915.....	1, 151. 43

**Bureau of Fisheries—Continued.**

Marine Biological Station, N. C., 1915.....	\$2. 85
Fish hatchery, Cape Vincent, N. Y.....?	7. 89
Fish hatchery, Duluth, Minn.....	. 26
Fish hatchery, Edenton, N. C., 1915.....	603. 57
Fish hatchery, Kentucky.....	43. 75
Fish hatchery, upper Mississippi River Valley.....	31. 76
Fish hatchery, Washington.....	339. 44
Fish hatchery, Woods Hole, Mass., 1915.....	6, 768. 84
Vessels and boats, Alaska fishery service, 1915.....	1. 00
Refund of tonnage taxes and light dues to citizens of Philippine Islands (indefinite).....	903. 30
<b>Total.....</b>	<b>177, 995. 27</b>

**Estimates for Fiscal Year Ending June 30, 1919.**

The estimates for the fiscal year 1919, aggregating \$18,156,065, exceed the estimates for the fiscal year 1918, which amount to \$17,184,185, by \$971,907.

A comparison of the estimates for 1919 with the total amount appropriated by Congress for the fiscal year 1918 shows that the estimates exceed the appropriation by \$3,827,580.

The major items of increase of the estimates for 1919 over the estimates for 1918 occur in the Lighthouse Service and the Bureau of Standards. In the former the excess is \$1,315,200, while the latter shows an increase of \$760,940. These increases are accounted for by necessary increase in the maintenance items in the Lighthouse Service, owing to the steadily increasing number of aids to navigation established under authority of law, and the greatly enlarged activities of the Bureau of Standards caused by its war work.

In the Bureau of Foreign and Domestic Commerce, the Coast and Geodetic Survey, the Bureau of Fisheries, and in items for public works in the Lighthouse Establishment, decreases under the estimates for the fiscal year 1918, aggregating \$1,186,000, appear.

Comparing the estimates for the fiscal year 1919 with the appropriations for the fiscal year 1918, the principal items of increase are shown in the bureaus and in the amounts given below:

Bureau of Foreign and Domestic Commerce.....	\$218, 650
Steamboat-Inspection Service.....	71, 375
Bureau of Standards.....	394, 440
Bureau of Lighthouses.....	1, 456, 950
Coast and Geodetic Survey.....	924, 540
Bureau of Fisheries.....	77, 620
Public works, Lighthouses.....	531, 700
<b>Total.....</b>	<b>3, 675, 275</b>



In submitting the estimates items aggregating \$387,400 were deducted. These cover activities in the Coast and Geodetic Survey and the Bureau of Fisheries, temporarily suspended by reason of the fact that vessels and men belonging to these services have been transferred, under authority of law, to the War and Navy Departments, and the expenses therefore are being paid by these departments. A very much larger decrease in the estimates could have been submitted had it been possible to include the Bureau of Lighthouses, from which many vessels and employees have been transferred to the jurisdiction of the Navy Department, but the law under which these transfers are made requires the payment for the maintenance of these vessels and the payment of the salaries of the employees first from the regular annual appropriations for the Lighthouse Service, making up any deficiency from appropriations for the military services.

The estimates contain no recommendations for increase of the salaries of any of the personnel of the Department, except that provision is made for increased compensation to crews of vessels in accordance with agreements made fixing generally the rates of compensation to crews of merchant vessels. The compensation provided for in the estimates is equal to the salaries thus fixed.

In some offices the salary scale is made a little higher by providing positions of higher grades and omitting positions in lower grades. This is necessary because it has been found impossible to fill positions in the Department in the lower grades from certifications of the Civil Service Commission since eligibles willing to serve at the lower salaries could not be obtained.

The table following gives the details of all items of estimates for the fiscal year 1919 as compared with items of appropriations for the fiscal year 1918.

COMPARISON BETWEEN THE ITEMS OF ESTIMATES FOR THE DEPARTMENT OF COMMERCE SUBMITTED FOR THE FISCAL YEAR 1919 AND APPROPRIATIONS BY CONGRESS FOR THE FISCAL YEAR 1918.

	Estimates, 1919.	Appropriation, 1918.	Increase.
<b>OFFICE OF THE SECRETARY.</b>			
Salaries.....	\$198,640	\$181,000	
Contingent expenses.....	75,000	60,000	
Rent.....	66,500	66,500	
Rent of storage space.....	1,000		
<b>Total.....</b>	<b>341,140</b>	<b>307,500</b>	<b>\$24,640</b>
<b>LIGHTHOUSE SERVICE.</b>			
Salaries, Bureau of Lighthouses.....	67,030	65,130	
General expenses.....	3,608,800	2,850,000	
Salaries, keepers of lighthouses.....	1,080,000	940,000	
Salaries, lighthouse vessels.....	1,650,000	1,104,650	
Salaries, Lighthouse Service.....	391,000	380,000	
<b>Public works:</b>			
Guantanamo Bay, Cuba, aids to navigation.....	14,000		
Depot for second lighthouse district.....	85,000		
Detroit, Mich., lighthouse depot.....	53,000		
Hawaiian Islands, lighthouse depot.....	90,000		
Light-keepers' dwellings.....	75,000		
Sand Island Light Station, Ala.....	45,000		
Gulf Coast, La., light vessel.....	160,000		
Spectacle Reef Light Station, Mich.....	28,000		
Depot for fifth lighthouse district.....	\$75,000		
Tender for third lighthouse district.....	200,000		
Tender for fifth lighthouse district.....	200,000		
Ambrose Channel, N. Y., lighted buoys.....	26,000		
Joe Flogger Shoal, Del., aids to navigation.....	40,000		
St. Marys River, Mich., aids to navigation.....	80,000		
Staten Island, N. Y., lighthouse depot.....	30,000		
Additional gas buoys fifth lighthouse district.....	65,000		
Tender for fifth lighthouse district.....	200,000		
Virgin Islands, West Indies, aids to navigation.....	50,000		
Aransas Pass Light Station, Tex.....	\$ 20,000		
Potomac River, Md., aids to navigation.....	95,000		
Tender for third lighthouse district.....		150,000	
Cape Charles Light Vessel, Va.....		130,000	
Light vessel for general lake service.....		150,000	
Aids to navigation, Pearl Harbor, Hawaii.....		80,000	
Staten Island lighthouse depot, N. Y.....		\$1,000	
Aids to navigation, Huron Harbor, Ohio.....		4,500	
Point Borinquen Light Station, P. R.....		85,000	
Chicago Harbor Light Station, Ill.....		88,000	
Aids to navigation, Fairport Harbor, Ohio.....		42,000	
Sand Hills Light Station, Mich.....		70,000	
Manitowoc Breakwater Light Station, Wis.....		\$1,000	
Aids to navigation, East River, N. Y.....		16,000	
Aids to navigation, Keweenaw Waterway, Mich.....		105,000	
Aids to navigation, Cape Charles City, Va.....		12,800	
Aids to navigation, Chesapeake Bay, Md. and Va.....		29,000	
Aids to navigation, Alaska.....		60,000	
Aids to navigation, Indiana Harbor, Ind.....		100,000	

\* Appropriated by urgent deficiency act of Oct. 6, 1917.

COMPARISON BETWEEN THE ITEMS OF ESTIMATES FOR THE DEPARTMENT OF COMMERCE SUBMITTED FOR THE FISCAL YEAR 1919 AND APPROPRIATIONS BY CONGRESS FOR THE FISCAL YEAR 1918—Continued.

	Estimates, 1919.	Appropriation, 1918.	Increase.
<b>LIGHTHOUSE SERVICE—continued.</b>			
<b>Public works—Continued.</b>			
Great Salt Point Light Station, R. I.....		\$20,000	
Radio installation on lighthouse tenders.....		60,000	
Aids to navigation, Washington and Oregon.....		35,000	
Aransas Pass Light Station, Tex.....		20,000	
<b>Total.....</b>	<b>\$8,627,830</b>	<b>6,639,180</b>	<b>\$1,988,650</b>
<b>BUREAU OF THE CENSUS.</b>			
Salaries.....	789,360	676,460	
Collecting statistics.....	559,000	647,000	
Tabulating machines and integrating counter.....	60,000	60,000	
For the construction, purchase, rental, or repair of punching machines.....	70,000		
<b>Total.....</b>	<b>1,478,360</b>	<b>1,383,460</b>	<b>94,900</b>
<b>BUREAU OF FOREIGN AND DOMESTIC COMMERCE.</b>			
Salaries.....	163,320	154,120	
Promoting commerce.....	135,000	125,000	
Promoting commerce, South and Central America.....	100,000	100,000	
Promoting commerce, Far East.....	100,000		
Commercial attachés.....	200,000	100,000	
National security and defense (inland waterways).....		550	
<b>Total.....</b>	<b>698,320</b>	<b>479,670</b>	<b>218,650</b>
<b>STEAMBOAT-INSPECTION SERVICE.</b>			
Salaries, Office of Supervising Inspector General.....	19,440	18,240	
Salaries, Steamboat-Inspection Service.....	463,300	434,100	
Clerk hire.....	116,900	90,000	
Contingent expenses.....	140,000	120,000	
Steamboat-Inspection Service, Tampa, Fla.....		5,925	
<b>Total.....</b>	<b>739,640</b>	<b>668,265</b>	<b>71,375</b>
<b>BUREAU OF NAVIGATION.</b>			
Salaries.....	39,530	38,130	
Salaries, Shipping Service.....	30,400	28,600	
Clerk hire, Shipping Service.....	47,700	45,000	
Contingent expenses.....	8,365	7,500	
Admeasurement of vessels.....	3,500	3,500	
Instruments for counting passengers.....	250	250	
Enforcement of navigation laws.....	33,000	42,000	
Preventing overcrowding of passenger vessels.....	18,000	18,000	
Enforcement of wireless-communication laws.....	45,000	45,000	
<b>Total.....</b>	<b>225,745</b>	<b>227,980</b>	<b>a 2,235</b>

a Decrease.

COMPARISON BETWEEN THE ITEMS OF ESTIMATES FOR THE DEPARTMENT OF COMMERCE SUBMITTED FOR THE FISCAL YEAR 1919 AND APPROPRIATIONS BY CONGRESS FOR THE FISCAL YEAR 1918—Continued.

	Estimates, 1919.	Appropriation, 1918.	Increase.
<b>BUREAU OF STANDARDS.</b>			
Salaries.....	\$482,840	\$348,900	
Equipment.....	100,000	55,000	
Repairs and alterations.....	7,500	5,000	
General expenses.....	50,000	35,000	
Improvement and care of grounds.....	10,000	6,000	
High-potential investigation.....	25,000	15,000	
Testing structural materials.....	175,000	100,000	
Testing machines.....	35,000	30,000	
Investigation of fire-resisting properties.....	60,000	25,000	
Investigation of public-utility standards.....	100,000	50,000	
Investigation of railway materials.....	20,000	15,000	
Testing miscellaneous materials.....	35,000	20,000	
Radio communication.....	40,000	10,000	
Color standards.....	10,000	10,000	
Investigation of clay products.....	30,000	10,000	
Determining physical constants.....	15,000	5,000	
Standardization and testing of mechanical appliances.....	25,000	10,000	
Investigation of optical glass.....	25,000	10,000	
Standard materials.....	4,000		
To investigate textiles, paper, leather, rubber, etc.....	20,000		
Investigation of the electrodeposition of metals.....	10,000		
Research fellowships.....	15,000		
Metallurgical research.....	50,000		
Investigation of chemical reagents.....	15,000		
Illumination investigation.....	10,000		
Radioactivity.....	10,000		
Mine scales investigation.....	15,000		
Magnetic analysis.....	10,000		
Insulating materials.....	10,000		
Military research.....	250,000	250,000	
Gauge standardization.....	150,000	150,000	
Renewal of storage batteries.....	20,000		
Sea-water concrete investigation.....	15,000		
Testing large scales.....	40,000	40,000	
Testing machine.....	25,000		
Site for testing laboratory.....	50,000		
Fireproof building for testing laboratory.....	25,000		
Test-car depot.....	30,000		
National security and defense (optical glass).....		75,000	
National security and defense (temporary building).....		250,000	
Equipping chemical laboratory building.....		35,000	
Radio laboratory, Bureau of Standards.....		40,000	
Additional land.....		25,000	
<b>Total.....</b>	<b>\$1,019,340</b>	<b>1,624,900</b>	<b>\$394,440</b>

COMPARISON BETWEEN THE ITEMS OF ESTIMATES FOR THE DEPARTMENT OF COMMERCE SUBMITTED FOR THE FISCAL YEAR 1919 AND APPROPRIATIONS BY CONGRESS FOR THE FISCAL YEAR 1918—Continued.

	Estimates, 1919.	Appropriation, 1918.	Increase.
<b>BUREAU OF FISHERIES.</b>			
Salaries.....	\$476,580	\$432,560	
Miscellaneous expenses.....	678,000	610,500	
Fish hatcheries:			
Berkshire, Mass., trout hatchery.....	5,000		
St. Johnsbury, Vt.....	5,000		
Woods Hole, Mass.....	18,600		
Wytheville, Va.....	20,000		
Yes Bay, Alaska.....	25,000		
Alaska.....	10,000		
Fur-seal Islands, Alaska, power lighter.....	20,000		
Fur-seal Islands, Alaska, construction and repair of buildings.....	15,000		
Repairs to steamer <i>Fish Hawk</i> .....		35,000	
Payments to Great Britain and Japan under article 11 of Fur Seal Convention.....		20,000	
Distribution cars, Bureau of Fisheries.....		15,000	
Fish hatcheries:			
Bozeman, Mont.....		7,500	
Cape Vincent, N. Y.....		5,500	
Edenton, N. C. (special).....		3,500	
South Carolina.....		3,500	
San Marcos, Tex.....		7,500	
Wyoming.....		7,000	
Woods Hole, Mass.....		3,000	
Protecting seal and salmon fisheries of Alaska.....		35,000	
Developing aquatic sources of leather.....		10,000	
Total.....	1,273,180	1,195,560	\$77,620
<b>COAST AND GEODETIC SURVEY.</b>			
Party expenses.....	433,100	487,600	
Repairs of vessels.....	36,000	56,000	
Pay, etc., officers and men, vessels.....	278,800	320,000	
Salaries.....	545,310	444,270	
General expenses.....	90,000	72,100	
Milling machine.....	1,200		
Lathes.....	3,000		
Drill presses.....	600		
Electrotype plate machine.....	3,000		
Waterproofing vaults.....	2,500		
New vessels.....	933,000		
Automatic sprinkler system for the Coast and Geodetic Survey.....		12,000	
Additional surveying instruments for the Coast and Geodetic Survey.....		10,000	
Total.....	2,326,510	1,401,970	924,540
Printing and binding.....	425,000	400,000	25,000
Grand total.....	18,156,065	14,328,485	3,827,580
Decrease.....			2,235
Total increase.....			3,827,580

**Personnel.**

While the additions to the personnel of the Department during the past year have not been more than was required by the gradual growth of the Department, the additional work demanded by the war situation has necessitated an addition of upwards of 550 employees, about equally divided between the Bureau of Standards and the Bureau of Foreign and Domestic Commerce. The addition to the latter bureau was, however, withdrawn from this Department on August 27, 1917, when the work on which it was engaged was placed under the jurisdiction of the War Trade Board.

The accompanying table shows, by bureaus, the number of permanent positions in the Department on July 1, 1917, and the increase or decrease in each bureau as compared with July 1, 1916. The figures do not include temporary appointments, nor do they include the following appointments or employments not made by the head of the Department: Persons engaged in rodding, chaining, recording, heliotroping, etc., in field parties of the Coast and Geodetic Survey; temporary employments in field operations of the Bureau of Fisheries; mechanics, skilled tradesmen, and laborers, employed under authority of Schedule A, Subdivision I, section 12, of the civil-service rules in the Lighthouse Service. Enlisted men on vessels of the Coast Survey in the Philippine Islands and officers and men of the Navy Department employed on vessels of the Bureau of Fisheries are also excluded. The total of these excluded miscellaneous employments and enlistments is approximately 4,524. At the close of the fiscal year there were 466 employees in the service of the Department serving under temporary appointment or employment.

Bureau.	Statutory.	Non-statutory.	Total.	In District of Columbia.	Outside District of Columbia.	Increase (+) or decrease (-).
Office of the Secretary.....	172	.....	172	172	.....	+ 1
Bureau of the Census.....	563	684	1,247	<sup>a</sup> 591	656	- 13
Bureau of Foreign and Domestic Commerce.....	113	120	233	129	104	+ 35
Bureau of Standards.....	278	240	518	448	70	+ 95
Bureau of Fisheries.....	418	34	452	80	372	+ 18
Bureau of Lighthouses.....	55	5,658	<sup>b</sup> 5,713	38	5,675	+ 15
Coast and Geodetic Survey.....	289	501	790	<sup>c</sup> 315	475	+ 20
Bureau of Navigation.....	<sup>e</sup> 43	124	167	34	133	+ 6
Steamboat-Inspection Service.....	246	75	321	12	309	+ 19
Total.....	2,177	7,436	9,613	1,819	7,794	+ 196

<sup>a</sup> Employees engaged in work in the field for a part of each year with headquarters in Washington are treated as within the District of Columbia.

<sup>b</sup> Includes the following positions, appointment to which is not made by the head of the Department: 323 (233 classified competitive and 90 classified excepted) mechanics, skilled tradesmen, and laborers employed in field construction work in the Lighthouse Service and work of a similar character at the general lighthouse depot at Tompkinsville, N. Y., 1,525 laborers in charge of post lights, and 1,597 members of crews of vessels.

<sup>c</sup> Includes stenographers and typewriters authorized by law and not to be employed exceeding six months.

The total force—statutory, nonstatutory, and miscellaneous, as above—is therefore approximately 14,137 persons.

The following tables give a summary of changes in the personnel of the Department for the fiscal year ended June 30, 1917:

#### APPOINTMENTS, PROMOTIONS, AND REDUCTIONS.

Bureau.	Appointments. <sup>a</sup>						Promo- tions.	Reduc- tions.
	Permanent.				Tempo- rary.	Grand total.		
	Com- peti- tive.	Ex- cepted.	Un- classi- fied.	Total.				
Office of the Secretary.....	34	3	3	40	9	49	45	.....
Bureau of the Census.....	57	10	141	208	201	409	103	1
Bureau of Foreign and Domestic Commerce.....	41	79	.....	120	67	187	66	8
Bureau of Standards.....	163	.....	14	177	161	338	219	3
Bureau of Fisheries.....	62	6	14	82	69	151	65	8
Bureau of Lighthouses.....	341	54	.....	395	233	628	b 830	118
Coast and Geodetic Survey.....	74	1	8	77	94	171	141	71
Steamboat-Inspection Service.....	53	2	.....	55	36	91	26	.....
Bureau of Navigation.....	38	4	6	48	74	122	31	1
Total.....	863	159	180	1,202	944	2,146	1,526	210

#### SEPARATIONS AND MISCELLANEOUS CHANGES.

Bureau.	Separations. <sup>c</sup>						Miscellaneous changes. <sup>d</sup>
	From permanent positions.				From temporary positions.	Grand total.	
	Competitive.	Excepted.	Unclassified.	Total.			
Office of the Secretary.....	36	1	4	41	7	48	9
Bureau of the Census.....	53	7	152	212	100	312	11
Bureau of Foreign and Domestic Commerce.....	26	25	2	53	46	99	21
Bureau of Standards.....	110	.....	6	116	88	204	14
Bureau of Fisheries.....	66	7	16	89	24	113	31
Bureau of Lighthouses.....	364	50	.....	414	132	546	65
Coast and Geodetic Survey.....	64	.....	2	66	40	106	6
Steamboat-Inspection Service.....	26	1	.....	27	18	45	23
Bureau of Navigation.....	33	.....	10	43	35	78	9
Total.....	778	91	192	1,061	490	1,551	189

<sup>a</sup> Includes appointments of the following character: Presidential, by selection from civil-service certificates, under Executive order, to excepted positions, by reinstatement, and by reason of transfer within the Department or from other departments or independent establishments.

<sup>b</sup> Includes 447 temporary increases in the personnel of the vessels.

<sup>c</sup> Includes separations by reason of resignations, discontinuances, removals, deaths, transfers within the Department, and transfers from the Department to other departments or independent establishments.

<sup>d</sup> Includes reappointments by reason of change of station, name, designation, or appropriation, extension of temporary appointments, changes from temporary to permanent status, etc.

The efficiency of some services is impaired by reason of superannuated employees. An equitable retirement law would promote efficiency and do justice. The Government is in this respect, so far as its clerical force is concerned, behind the best commercial and industrial practice of the time. The present policy is not only penny-wise and pound-foolish but at times is the cause of cruel injustice to worthy public servants. Furthermore, it is hardly fair to make fish of one service and fowl of another, to provide retirement for some cases and leave others unprovided. The Coast Guard has the retirement privilege, and rightly so, but the Lighthouse Service, the Coast and Geodetic Survey, and the Fisheries Service in their marine, work done with equal risk and difficulty, have not. There is no reason why discrimination should be made against them.

Closely allied to the question of retirement is that of disability compensation. Not long since regarded as an academic question, later accepted for a limited number of branches of the service, it has at last become a matter of general benefit by the passage of the act approved September 7, 1916, to provide compensation for employees of the United States suffering injuries incurred while in the performance of their duties.

The Department has found it necessary, owing to the high cost of living and conditions in the commercial and industrial world, to offer higher entrance salaries for positions of clerk, stenographer and typewriter, and those of a scientific and mechanical nature in some cases.

The increased rates of pay given in the merchant marine, combined with the advancing cost of living, rendered it difficult to retain in the service the personnel of the vessels of the Department. It was found necessary from time to time to make such increases of compensation in the marine services as the appropriations would permit. Even with this encouragement and that afforded by the general increases made July 1, 1917, the pay of the marine personnel is generally much lower than that for like duties in the merchant marine. Particular attention is asked to Appendix E on this subject.

While the 5 and 10 per cent increase in the compensation of employees earning \$1,800 or less per annum is appreciated by those concerned, it can only be looked upon as a partial, as it is a temporary attempt to relieve the pressure of the high cost of living. There is a phase of the question to be given weight by



any who study the Government service from an economical point of view, namely, the constant and costly drain upon the skilled workers of that service caused by the withdrawal of its best material to private work which offers better inducements. A capable Government clerk can not be made quickly, and the securing and training of new material to replace those seduced into other channels is a constant source of expense and a loss of efficiency.

It is the policy of the Department to afford women seeking Government employment as many opportunities as possible, particularly in clerical positions. They are appointed upon the same conditions and with the same compensation as are prescribed for men. Great difficulty has been experienced in obtaining qualified male eligibles, and an unusual opportunity has therefore arisen for the appointment of women who pass the civil-service examinations. During the past four months women were given 140 out of a total of 217 probational appointments in clerical positions.

It continues to be the definite policy of the Department to afford its own employees every possible means of advancement within its own services. It is the practice not to fill vacancies in higher grades by transfers from other departments so long as there are employees eligible and capable of performing well the duties of the higher positions. The Department desires that in each of its services a knowledge of the operations of the various offices be extended as broadly as possible among the staff so as to encourage the junior employees to learn the work in all its forms that they may be ready for the duties of higher grade positions which may become vacant. The result of this policy appears in the fact that in the last fiscal year the Department authorized 1,526 promotions and increases in pay as compared to 1,376 in the fiscal year ended June 30, 1916, and 838 in the fiscal year ended June 30, 1915. There were only 10 transfers made from other departments or independent offices at more than the usual entrance salary during the fiscal year ended June 30, 1917. In each case it was specifically shown that the vacancies could not adequately be filled by promotions or transfers within the Department.

The leave privilege is generally exercised in a considerate manner.

TOTAL AND AVERAGE AMOUNT OF ANNUAL<sup>a</sup> AND SICK LEAVE, BY BUREAUS, STATED SEPARATELY AND TOGETHER, TAKEN BY THE EMPLOYEES OF THE DEPARTMENT IN THE DISTRICT OF COLUMBIA, ARRANGED ACCORDING TO SEX, DURING THE CALENDAR YEAR 1916, AND THE AVERAGE LEAVE FOR 1915.

## MALE.

Bureau.	Number.	Annual leave.		Sick leave.		Total.		Average 1915.
		Days.	Average.	Days.	Average.	Days.	Average.	
Office of the Secretary.....	97	2,645	27.27	613½	6.32	3,258½	33.59	32.91
Bureau of the Census.....	288	8,408	29.19	2,180	7.57	10,588	36.76	35.52
Bureau of Foreign and Domestic Commerce.....	88	2,532	28.77	609	6.92	3,141	35.69	34.07
Bureau of Standards.....	267	7,206	26.99	1,158½	4.34	8,364½	31.33	31.91
Bureau of Fisheries.....	51	1,236	24.24	238½	4.68	1,474½	28.92	30.54
Bureau of Lighthouses.....	31	918	29.61	192	6.19	1,110	35.80	36.90
Coast and Geodetic Survey..	165	4,632	28.07	951	5.76	5,583	33.83	33.15
Bureau of Navigation.....	19	539	28.37	61	3.21	600	31.58	34.13
Steamboat-Inspection Service.....	9	240	26.66	25	2.78	265	29.44	28.81
Total and average.....	1,015	28,356	27.94	6,028½	5.94	34,384½	33.88	33.51

## FEMALE.

Office of the Secretary.....	47	1,287	27.38	462½	9.84	1,749½	37.22	33.01
Bureau of the Census.....	252	7,518	29.83	2,711½	10.76	10,229½	40.59	40.85
Bureau of Foreign and Domestic Commerce.....	14	410	29.28	114½	8.18	524½	37.46	38.50
Bureau of Standards.....	2	60	30.00	18	9.00	78	39.00	49.75
Bureau of Fisheries.....	20	581	29.05	132	6.60	713	35.65	35.41
Bureau of Lighthouses.....	3	90	30.00	60	20.00	150	50.00	45.00
Coast and Geodetic Survey..	13	382	29.38	140	10.77	522	40.15	37.90
Bureau of Navigation.....	5	148	29.60	71	14.20	219	43.80	41.30
Steamboat-Inspection Service.....								
Total and average.....	356	10,476	29.43	3,709½	10.42	14,185½	39.85	39.63

## TOTAL.

Office of the Secretary.....	144	3,932	27.31	1,076	7.47	5,008	34.78	32.94
Bureau of the Census.....	540	15,926	29.49	4,891½	9.06	20,817½	38.55	37.96
Bureau of Foreign and Domestic Commerce.....	102	2,942	28.84	723½	7.09	3,665½	35.93	34.65
Bureau of Standards.....	269	7,266	27.01	1,176½	4.37	8,442½	31.38	32.04
Bureau of Fisheries.....	71	1,817	25.59	370½	5.22	2,187½	30.81	31.78
Bureau of Lighthouses.....	34	1,008	29.65	252	7.41	1,260	37.06	37.61
Coast and Geodetic Survey..	178	5,014	28.17	1,091	6.13	6,105	34.30	33.42
Bureau of Navigation.....	24	687	28.63	132	5.50	819	34.13	35.46
Steamboat-Inspection Service.....	9	240	26.66	25	2.78	265	29.44	28.81
Total and average.....	1,371	38,832	28.32	9,738	7.10	48,570	35.42	35.00

<sup>a</sup> In the count of the annual leave all periods of one-half day and over were counted as a full day; periods of less than one-half day were omitted.

The following statement, based on the percentages of the foregoing table, shows the relative standing of the bureaus for the calendar years 1916 and 1915 with respect to the lowest average amount of leave used:

Bureau.	Annual leave.		Sick leave.		Total.	
	1916	1915	1916	1915	1916	1915
Office of the Secretary.....	4	3	8	3	6	4
Bureau of the Census.....	8	8	9	9	9	9
Bureau of Foreign and Domestic Commerce.....	7	4	6	6	7	6
Bureau of Standards.....	3	2	2	2	3	3
Bureau of Fisheries.....	1	1	3	5	2	2
Bureau of Lighthouses.....	9	9	7	8	8	8
Coast and Geodetic Survey.....	5	6	5	4	5	5
Bureau of Navigation.....	6	7	4	7	4	7
Steamboat-Inspection Service.....	2	5	1	1	1	1

I renew my approval of continuing the Saturday half holiday throughout the year.

#### Printing and Binding.

The sundry civil act approved July 1, 1916, allotted to the Department \$400,000 for printing and binding during the fiscal year 1917. Of this allotment \$382,602.76 was expended, leaving an unused balance on June 30 of \$17,397.24. The decrease in expenditures for printing and binding in 1917 compared with 1916 was \$7,235.52 (or 1.86 per cent), the allotment in 1916 being \$390,000 and the expenditures \$389,838.28.

The estimated cost of unbilled and uncompleted work of the Department at the Government Printing Office on July 1, 1917, was \$69,756.48, while the actual cost of such work at that office on July 1, 1916, was \$68,771.41.

During the fiscal year 1917 the Department issued on the Public Printer 2,722 requisitions for printing and binding, which was a decrease of 987 compared with 1916. At the close of business June 30, 1917, there were at the Government Printing Office 416 requisitions on which deliveries of completed work had not been made, compared with 379 on the same date in 1916.

The following table gives the cost of printing and binding for each of the bureaus, offices, and services of the Department during the fiscal years 1916 and 1917 as well as the increase or decrease in 1917 for each bureau, office, and service and the

estimated cost of the work on hand but not completed June 30, 1917:

Bureau, office, or service.	Cost of work delivered.		Increase (+) or decrease (-).		Estimated cost of work not completed June 30, 1917.
	1916	1917	Cost.	Per cent.	
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, Chief Clerk, and Division of Publications).....	\$16,581.71	\$15,432.08	-\$1,149.63	- 6.93	\$1,999.32
Appointment Division.....	236.86	373.00	+ 136.14	+57.48	196.60
Disbursing Office.....	747.23	696.21	- 51.02	- 6.83	65.60
Division of Supplies.....	601.39	124.85	- 476.54	-69.26	5.81
Bureau of the Census.....	84,766.94	115,971.35	+31,204.41	+36.81	33,593.86
Coast and Geodetic Survey.....	28,795.27	28,685.67	- 109.60	- .38	10,959.41
Bureau of Fisheries.....	12,460.20	16,432.46	+ 3,972.26	+31.88	3,114.87
Bureau of Foreign and Domestic Commerce.....	131,262.35	121,529.73	- 9,732.62	- 7.41	9,677.08
Bureau of Lighthouses.....	21,080.27	18,569.17	- 2,511.10	-11.91	624.19
Lighthouse Service.....	7,208.17	4,771.61	- 2,436.56	-33.80	1,958.74
Bureau of Navigation.....	16,928.50	14,740.06	- 2,188.44	-12.93	37.84
Shipping Service.....	4,478.48	2,491.36	- 1,987.12	-44.37	541.19
Radio Service.....	894.76	589.98	- 304.78	-34.06	9.64
Bureau of Standards.....	35,824.68	23,649.34	-12,175.34	-33.99	4,313.96
Office of the Supervising Inspector General,					
Steamboat-Inspection Service.....	2,335.03	1,009.08	- 1,325.95	-56.79	436.68
Steamboat-Inspection Service.....	14,466.86	10,701.05	- 3,765.81	-26.03	535.45
Customs Service.....	11,169.58	6,775.76	- 4,393.82	-39.34	1,684.24
<b>Total.....</b>	<b>389,838.28</b>	<b>382,602.76</b>	<b>- 7,235.52</b>	<b>- 1.86</b>	<b>69,756.48</b>

The amount and cost of each class of work called for by requisitions on the Public Printer during the fiscal years 1916 and 1917 are comparable in the following statement:

Class.	1916	1917	Increase (+) or decrease (-).	
	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Per cent.</i>
Blank forms .....	15,859,014	17,298,211	+1,439,197	+ 9.07
Reports, pamphlets, etc. ....	4,447,984	4,016,515	- 431,469	- 9.70
Letterheads .....	3,192,000	3,562,000	+ 370,000	+11.59
Envelopes .....	136,675	50,000	- 86,675	-63.42
Circulars, summaries, and notices .....	2,900,900	384,475	-2,516,425	-86.75
Index cards .....	1,133,500	1,837,400	+ 703,900	+62.10
Guide cards and folders .....	305,000	88,500	- 216,500	-70.98
Memorandum sheets .....	3,355,500	1,586,000	-1,769,500	-52.73
Blank books .....	19,955	27,191	+ 7,236	+36.26
Miscellaneous books (binding) .....	5,898	2,866	- 3,032	-51.41
	<i>Cost.</i>	<i>Cost.</i>	<i>Cost.</i>	<i>Per cent.</i>
Blank forms .....	\$38,128.35	\$33,246.00	-\$4,882.35	-12.81
Reports, pamphlets, etc. ....	309,652.01	320,981.44	+11,329.43	+ 3.66
Letterheads .....	4,441.32	4,971.42	+ 530.10	+11.94
Envelopes .....	404.38	210.71	- 193.67	-47.89
Circulars, summaries, and notices .....	8,194.77	2,118.95	- 6,075.82	-74.14
Index cards .....	917.97	1,268.75	+ 350.78	+38.21
Guide cards and folders .....	1,264.69	857.81	- 406.88	-32.17
Memorandum sheets .....	2,454.04	407.24	- 2,046.80	-83.41
Blank books .....	14,686.95	8,190.64	- 6,496.31	-44.23
Miscellaneous books (binding) .....	9,179.56	9,513.53	+ 333.97	+ 3.64
Miscellaneous .....	514.24	836.27	+ 322.03	+62.62
Total .....	389,838.28	382,602.76	- 7,235.52	- 1.86

During the fiscal year 1917 the Department issued 1,192 publications, compared with 1,945 during the fiscal year 1916. Those issued in 1917 contained a total of 54,407 printed pages, compared with 61,702 in 1916, and there were printed of them for the Department a grand total of 4,444,200 copies, against 7,124,035 in the preceding year, a decrease of 2,679,835. In both the number of publications issued and copies printed, however, 1916 was an abnormal year, due to the printing and distribution during that year by the Bureau of the Census of 789 advance press summaries of the results of the census of manufactures in 1914, of which 1,200,000 copies were printed, and the printing and distribution by the Bureau of Foreign and Domestic Commerce of 1,500,000 circulars used in the campaign for saving waste paper. The figures for 1917 are considerably larger than those for any fiscal year preceding 1916.

The publication work of each bureau of the Department for the fiscal years 1915, 1916, and 1917 are summarized in the following table:

Bureau or office. <sup>a</sup>	Publications.			Pages.		
	1915	1916	1917	1915	1916	1917
Office of the Secretary.....	64	77	78	2,237	2,428	3,006
Bureau of the Census.....	138	836	135	19,937	14,165	13,161
Coast and Geodetic Survey.....	29	56	62	3,197	3,960	3,097
Bureau of Fisheries.....	57	81	81	3,159	2,620	2,440
Bureau of Foreign and Domestic Commerce.....	494	575	553	18,708	21,645	17,803
Bureau of Lighthouses.....	87	129	111	3,548	4,361	3,087
Bureau of Navigation.....	17	23	22	2,523	3,207	3,102
Bureau of Standards.....	137	150	122	6,662	8,328	6,623
Steamboat-Inspection Service.....	15	18	28	1,330	988	2,088
<b>Total.....</b>	<b>1,038</b>	<b>1,945</b>	<b>1,192</b>	<b>61,301</b>	<b>61,702</b>	<b>54,407</b>

Bureau or office.	Copies printed for Department.			Cost. <sup>b</sup>		
	1915	1916	1917	1915	1916	1917
Office of the Secretary.....	157,250	261,850	183,550	\$6,055.39	\$6,331.07	\$7,157.60
Bureau of the Census.....	524,625	1,432,910	645,150	97,830.49	54,283.37	92,562.23
Coast and Geodetic Survey.....	55,060	79,750	109,300	21,630.72	22,218.71	25,577.94
Bureau of Fisheries.....	68,200	171,350	339,700	11,902.88	10,339.36	11,681.49
Bureau of Foreign and Domestic Commerce.....	2,108,460	4,359,200	2,411,450	98,937.71	120,459.01	114,937.10
Bureau of Lighthouses.....	258,300	351,175	270,800	25,188.70	21,646.99	18,720.83
Bureau of Navigation.....	55,900	59,950	52,750	12,154.79	17,483.47	14,303.72
Bureau of Standards.....	153,400	203,050	138,300	19,408.79	28,209.20	21,202.22
Steamboat-Inspection Service.....	372,600	204,800	293,200	8,511.22	8,062.35	9,870.44
<b>Total.....</b>	<b>3,753,795</b>	<b>7,124,035</b>	<b>4,444,200</b>	<b>301,620.69</b>	<b>289,033.53</b>	<b>316,019.57</b>

<sup>a</sup> In 1915 the Bureau of Corporations (which has since been merged in the Federal Trade Commission) issued 10 publications, containing 2,550 pages, of which 24,100 copies, costing \$14,319.65, were printed. These figures, however, are excluded from this table and from computations based on figures therein in order to reach more accurate comparisons in the work of the other bureaus and the Department as a whole.

<sup>b</sup> Figures relate to publications actually delivered to the Department during the year; consequently they do not agree with similar figures in a preceding table giving the cost of work done by the Government Printing Office during the fiscal year. Frequently the cost of a publication is charged against allotments for two or more fiscal years.

During the last fiscal year 3,593,563 publications and printed circulars of the Department were distributed to the public through the Division of Publications, compared with 3,648,311 during the fiscal year 1916, a decrease of 54,748. Of the total number distributed in 1917, 3,154,108 were wrapped and mailed by the Superintendent of Documents and 439,455 by the Division of Publications. Those wrapped and mailed by the Superintendent

of Documents comprised a mailing-list distribution of 2,479,240 and a distribution in response to individual requests of 674,868.

There were received and acted on during the year 106,301 miscellaneous requests, calling for 891,971 copies of publications, compared with 104,833 requests, calling for 605,110 copies, in 1916. This was an average of 354 requests and 2,973 publications for each working day, against an average of 349 requests and 2,017 publications during the preceding year.

The Department has established a number of mailing lists for use in sending typewritten or multigraphed information, as well as publications, to persons interested in its various activities. These are maintained in the Division of Publications. On July 1, 1917, there were in the Division 352 lists, containing 278,442 names, compared with 348 lists, with 267,939 names, a year ago. During the year 31,736 names were added to the lists and 21,233 were dropped from them; also 34 new lists were established and 30 were discontinued. There was, therefore, a net increase for the year of 4 lists and 10,503 names. More than 8,000 changes of address of persons on existing mailing lists were also made.

Stencils or plates are in use for 343 lists, with 265,757 names, of which the stencils or plates for 242 lists, with 193,256 names, are preserved in the Division and those for 101 lists, with 72,501 names, are kept in the office of the Superintendent of Documents. For 9 lists, comprising 12,685 names, address plates have not been embossed, the lists being preserved in card form only.

The 1916 high record of sales by the Superintendent of Documents of the Department's publications was maintained in 1917. In each of these years receipts from such sales were practically double those of any prior year. Tentative figures obtained from the Superintendent of Documents show that for the year ended June 30, 1917, 122,965 copies of reports and pamphlets issued by the Department were disposed of by his office through miscellaneous sales and 3,402,430 copies by annual subscriptions, a total of 3,525,395 copies. The figures for 1916 were 89,768, 3,280,888, and 3,370,656, respectively. The increases were, in miscellaneous sales, 33,197 copies; in subscriptions, 121,542 copies; and in the total, 154,739 copies.

Receipts from both sales and subscriptions were \$43,437.06 in 1917 and \$44,242.06 in 1916, a decrease of \$805. There were received from miscellaneous sales \$23,713.20 in 1917 and \$17,733.97 in 1916, an increase of \$5,979.23, and from subscriptions \$19,723.86 in 1917 and \$26,508.09 in 1916, a decrease of \$6,784.23.

The figures show an increase in the number of copies sold but a decrease in the total receipts therefrom. The decrease in receipts is accounted for entirely by the smaller number of subscriptions received during the year for the daily Commerce Reports (of which there were only 7,280 in 1917 compared with 9,920 in 1916, or a decrease of 2,640, at \$2.50 each), which in turn was due largely to conditions brought about by the war. The apparent inconsistency shown by a decrease in the receipts in the face of an increase in the number of copies disposed of is attributable to the fact that many subscriptions received during 1916 ran well into the succeeding year.

The Department gives wide publicity, through newspaper advertisements, to proposed contracts for materials and supplies. The following statement shows the cost of this advertising for several years:

Fiscal year.	Advertisements inserted.	Authorities to publish issued.	Insertions authorized.	Total cost.
1910.....	49	238	715	\$1,721.36
1911.....	26	86	260	439.40
1912.....	27	112	295	531.38
1913.....	33	153	434	660.46
1914.....	159	526	1,408	1,968.41
1915.....	226	797	2,143	3,058.14
1916.....	223	732	2,037	2,584.88
1917.....	237	708	1,816	<sup>a</sup> 2,191.07

<sup>a</sup> Figures subject to slight revision, owing to a few estimates of cost having been made in cases where newspapers have delayed rendering bills.

### Work of the Solicitor's Office.

During the fiscal year ended June 30, 1917, 267 contracts, totaling \$3,246,700, together with 22 contracts of indeterminate amounts; 50 leases, amounting to \$62,515; 20 revocable licenses, amounting to \$6,249; 44 insurance policies, in the sum of \$829,865; 7 deeds, in the sum of \$4,200; 180 contract bonds, amounting to \$281,058; and 104 official bonds, amounting to \$651,000, were examined (approved, disapproved, drafted, redrafted, or modified).

The number of legal opinions rendered, formal and informal (memorandum), totaled 404. Legislative matters handled which concern the Department of Commerce (drafting and redrafting of bills, reports relative thereto, etc.) numbered 349. In addition, 1,652 miscellaneous matters, embracing everything submitted for the advice or suggestion of the Solicitor, or for the formulation of departmental action, not included in the foregoing items, were handled by this office.



It would not, however, be correct to dismiss the work of the Solicitor's office with the above brief statement. The Solicitor has on a number of occasions served as Acting Secretary of the Department, involving the review and signing of many important papers. He has, in addition, ably and successfully represented the Department in numerous important conferences and negotiations. His office has been called upon for confidential inquiries which have been well and wisely made. All legislation affecting the Department is reviewed by the Solicitor and many measures, not only of departmental but of general public importance, have been drafted in his office. The entire force is one which constitutes a valuable and effective part of the Department.

### Motor Vehicles.

The motor-vehicle equipment of the Department in the District of Columbia consists of one motorcycle and two trucks operating from the Commerce Building and two trucks operating from the Bureau of Standards. The outfit has demonstrated its worth.

The motorcycle is used for special deliveries. It has traveled 3,752 miles during the fiscal year at a maintenance cost of \$0.014 per mile.

The 1,500-pound and 2,000-pound trucks quartered in the Commerce Building covered 11,327 and 9,074 miles, respectively, during the fiscal year, the former being operated at a cost of \$0.055 per mile and the latter at a cost of \$0.057 per mile.

The advanced price of gasoline, tires, and other equipment during 1917 increased maintenance cost fully 45 per cent. The following table summarizes the operation and maintenance cost of the equipment housed in the Commerce Building:

	1,500-pound truck.	2,000-pound truck.	Motor-cycle.
Mileage.....	11,327	9,074	3,752
Operating days.....	290	304	248
Average miles per diem.....	39.05	29.84	15.50
Gasoline consumption (gallons).....	969	847	97
Miles per gallon of gasoline.....	11.68	10.71	38.68
Operating expenses:			
Tires and tubes.....	\$262.64	\$194.93	.....
Repairs to tires and tubes.....	14.45	8.30	.....
Equipment.....	9.54	34.79	\$0.80
Miscellaneous supplies.....	6.65	12.14	.....
Gasoline.....	193.58	169.11	19.38
Cylinder oil.....	11.39	7.95	2.32
Repairs to machines.....	85.00	11.47	15.28
Replacements.....	41.74	22.07	17.05
Total operating expenses.....	624.99	518.08	54.83

The trucks operated from the Bureau of Standards performed service as follows:

	1,000- pound truck.	2,000- pound truck.
Mileage.....	11,873	7,053
Average miles per month.....	989	588
Gasoline consumption (gallons).....	920.50	878.50
Miles per gallon of gasoline.....	12.90	8.05

### Stock and Shipping Section.

There were received and filed by the stock and shipping section during the year 7,954 requisitions for supplies of all kinds, 3,336 for the offices and bureaus of the Department in Washington, and 4,618 for the outside services.

To fill the 4,618 requisitions for the outside services required the packing and shipping of 6,840 pieces, weighing 194,703 pounds, or over 97 tons.

The following table shows the number of books and blanks sent to each of the outside services during the year:

Service.	Blank books.	Blank forms.	Service.	Blank books.	Blank forms.
<b>Customs Service:</b>			<b>Lighthouse Service.....</b>	16,112	1,091,823
General.....	7,526	851,140	<b>Fisheries Service.....</b>	220	480,581
New York.....	56	63,200	<b>Miscellaneous.....</b>	120	66,680
<b>Shipping Service.....</b>	6,538	126,573	<b>• Total.....</b>	307,056	3,481,945
Radio Service.....	227	133,649			
Steamboat-Inspection Service..	276,257	668,299			

The following table gives the quantity of each class of printed stationery supplied during the year:

Envelopes.....	6,287,686	Blank books.....	4,942
Letterheads.....	686,000	Blank forms.....	188,674
Memorandum sheets.....	2,091,600	Index cards.....	975,100
Embossed letterheads.....	14,500	Guide cards.....	92,530
Embossed envelopes.....	5,600	Vertical folders.....	80,250
Stenographers' notebooks.....	2,241	Continuation sheets.....	565,500

In addition to the foregoing there were placed with the contractors 514 orders for 6,410,186 envelopes, costing \$8,042.63, of which 5,219,186 were used by the offices and bureaus of the Department located in Washington and 1,191,000 were used by the outside services.

**Exhibits.**

The Department made an exhibit of its work on the occasion of the fifth annual meeting of the Chamber of Commerce of the United States January 30–February 2, 1917. The Bureaus of the Census, Foreign and Domestic Commerce, Standards, Fisheries, and Lighthouses made appropriate exhibitions at the Industrial Exposition and Export Conference at Springfield, Mass., June 23–30, 1917.

**Authority to Make Purchases not Exceeding \$25 Without Obtaining Proposals.**

Your attention is again invited to the fact that Congress has not waived the application of section 3709 of the Revised Statutes to any purchase or service rendered for the Department when the aggregate amount involved does not exceed the sum of \$25.

Section 3709 reads:

All purchases and contracts for supplies or services, in any of the Departments of the Government, except for personal services, shall be made by advertising a sufficient time previously for proposals respecting the same, when the public exigencies do not require the immediate delivery of the articles, or performance of the service.

My last report said:

In the estimates submitted to Congress for the current fiscal year, this Department requested authority to make purchases not exceeding \$25 without complying with this provision of law, but the request was not given favorable consideration. During the fiscal year ended June 30, 1916, the Chief Clerk's Office issued 244 sets of proposals involving purchases not exceeding \$25 each. The average cost of each purchase amounted only to \$7.33. The number of proposals sent out for each purchase averaged 4. \* \* \* The clerical labor of writing, comparing, mailing, listing, receiving, tabulating, and writing awards on these proposals involved an expenditure almost as great as the cost of the articles purchased. No modern business concern would tolerate a system where the purchase cost bears such a relative value to the cost of the goods purchased. The general merit of the provision of section 3709 is admitted, but its requirements serve no useful purpose when applied to the large number of small purchases that are necessary. Congress has recognized the wisdom of removing small purchases from the requirements of this section by provisions similar to the one requested by this Department which were enacted into the laws applying to the Department of Agriculture and the District of Columbia.

During the fiscal year ended June 30, 1917, the Chief Clerk's Office issued 312 sets of proposals involving purchases not exceeding \$25. The average cost of each purchase amounted to \$8.05. The present procedure is wasteful and gets no result sufficient to warrant the outlay.

**Search for "Kroonland" Crew Continued.**

The Department has tried throughout the year to locate those members of the crew of the steamer *Kroonland* who, in October, 1913, assisted in rescuing the passengers of the burning steamer *Volturno*, but have not yet received the medals awarded them by Congress. Two of the crew were found. Alphons Roll wrote the Department from Galveston, Tex., in January, requesting that his medal be sent to him. He received it through the Steamboat-Inspection Service officials at Galveston. During December, Frank von Hymmen was located through the American consul general at Antwerp, Belgium, who stated that Von Hymmen was in the German army, on the western front. The medal was delivered to him through the Department of State.

Medals are still on hand for delivery to the following: Heike M. P. Janssen, Gérard Frans Borrenberg, Franz Quednau, Henri Guelinckx, Heinrich Schaub, Desiré Auguste Coopman, Ernst Benecke, Petrus Stobbelaar, Léon Coppens, Gustav Ebling, and August Friedrich Reckzügel.

**Department Library.**

The number of volumes in the Department library on June 30, 1917, was over 105,000, as against 103,000 a year ago. Approximately 3,550 volumes were discarded, in this way making room for new material.

One thousand one hundred and twenty-two trade and technical journals are received in the library. Many of these journals are sent regularly to the officials or persons engaged in special lines of work.

**Typewriter Purchases.**

The Department purchased during the year 319 typewriters 217 for use in the District of Columbia and 102 for the outside services. The total cost was \$21,177.75. The allowance for old machines given in exchange was \$3,309.50, making an outlay for new machines of \$17,868.25, an average price of \$56.01 paid for each machine.

**First-Aid Outfits in Commerce Building.**

First-aid outfits were installed in the Commerce Building, pursuant to authority given by Congress for such purchase in the appropriation act approved March 3, 1917.

### **Purchase of Dutch Harbor, Alaska, Recommended.**

I renew the recommendation on pages 179 and 180 of my report for 1915 and page 53 of my report for 1916 that the Government negotiate to purchase Dutch Harbor, the abandoned village of the North American Commercial Co. in Alaska. The condition described in my 1915 report still prevails, and the suggested purchase would be of profit to the Government.

### **Foundation for the Promotion of Industrial Peace.**

The special committee appointed by the trustees of the Foundation for the purpose of investing its funds, from time to time, under date of October 9, 1917, directed the treasurer of the Foundation, the American Security & Trust Co., of this city, to invest \$6,500 of the cash on hand in the Second Liberty Loan 4 per cent bonds of \$500 denominations. The condition of this fund on October 22, 1917, was as follows:

#### **Securities:**

Baltimore & Ohio Railroad Co. 4 per cent gold bonds due July 1, 1948..	\$10,000.00
Subscription to the Second Liberty Loan 4 per cent bonds.....	6,500.00
City of New York 4½ per cent corporate stocks, due May 1, 1957....	30,000.00
<b>Total securities.....</b>	<b>46,500.00</b>
<b>Cash on hand, income account.....</b>	<b>295.68</b>
<b>Grand total.....</b>	<b>46,795.68</b>

At a meeting of the special committee appointed by the trustees of the Foundation, held in the Office of the Secretary of Commerce on January 16, 1915, the following resolution was unanimously adopted:

*Resolved*, That the Congress be petitioned to permit the return to the Honorable Theodore Roosevelt of the Noble Peace Prize Fund, as it may stand in securities and cash at the time when the transfer is made, and for authority to dissolve the Foundation for the Promotion of Industrial Peace.

*Resolved*, That the special committee have authority to attend to all details growing out of the foregoing resolution.

In accordance with the provisions of this resolution, the Solicitor of the Department prepared bills to dissolve the foundation and return the funds to the donor. These bills have been introduced in each session of Congress for the past two years, but no action has been taken upon them.

### **Status of Proposed Legislation Affecting the Department.**

At my suggestion, a number of bills were prepared and introduced at the last session of the present Congress, but owing to the

fact that, as a general rule, only emergency measures were considered, none of these bills so introduced have as yet been enacted into law, though five of them were passed by the Senate, viz:

S. 1544, To provide for appeals from decisions of local inspectors of steam vessels and for other purposes.

S. 1545, To amend the act of March 3, 1913, entitled "An Act to regulate officering and manning of vessels subject to the inspection laws of the United States."

S. 1546, To permit the use of refined products of petroleum as stores on steam vessels carrying passengers.

S. 1547, To amend section 5 of the motor boat law, approved June 9, 1910.

S. 1549, To require numbering and recording of undocumented vessels.

The following legislation is pending in the House and Senate:

To promote export trade.

To provide for the retirement of officers and employees of the Bureau of Lighthouses and the Lighthouse Service.

To regulate the salaries of keepers of lighthouses.

To authorize aids to navigation and for other works in the Lighthouse Service.

Among the other important measures introduced affecting the Department were the following:

To amend section 4414 of the Revised Statutes of the United States, relating to the appointment of local and assistant inspectors of steam vessels.

Extending the benefits of care and treatment by the Public Health Service to seamen on vessels used in the service of the United States.

Ratifying the compact and agreement between the States of Oregon and Washington regarding concurrent jurisdiction of the waters of the Columbia River and its tributaries in connection with regulating, protecting, and preserving fish.

For the protection, regulation, and conservation of the fisheries of Alaska and for other purposes.

To establish fish-hatching and fish-cultural stations in the States of Alabama, California, Louisiana, Florida, Georgia, South Carolina or North Carolina, Maryland or Virginia, Oregon or Washington, Texas, Oklahoma, Illinois, Washington, Arizona, New Mexico, Michigan, Idaho, Missouri, Pennsylvania, Delaware or New Jersey, and Minnesota.

To protect and conserve the halibut fisheries of the Pacific Ocean, to establish closed seasons in halibut fishing in certain waters thereof, and to restrict the landing of halibut in the United States of America and the Territory of Alaska during the closed seasons established.

To provide for the appointment of certain assistant inspectors of the Steamboat-Inspection Service to ports where they are actually performing duty but to which they are at present detailed.

To provide for the appointment of 11 supervising inspectors, Steamboat-Inspection Service, in lieu of 10.

To amend section 13 of an act entitled "An Act to promote the welfare of American seamen in the merchant marine of the United States, to abolish arrest and imprisonment as a penalty for desertion and to secure the abrogation of treaty provisions in relation thereto; and to promote safety at sea," approved March 4, 1915.

To dissolve the Foundation for Promotion of Industrial Peace.

To amend section 4437 of the Revised Statutes of the United States relating to working steam pressure allowable on boilers on steam vessels, and section 4418 of the Revised Statutes of the United States relating to hydrostatic tests of steam boilers.

To amend sections 4402, 4404, and 4414 of the Revised Statutes of the United States relating to the Steamboat-Inspection Service.

To amend an act to regulate navigation on the Great Lakes and other connecting and tributary waters by allowing steam fog signals to be used by vessels at anchor.

To repeal that provision of an act approved June 7, 1906, entitled "An Act to amend section 7 of an act entitled 'An Act to provide for a permanent census office' approved March 6, 1902," which authorizes the Director of the Census to collect decennial statistics relating to express business.

To provide for the registry of officers, clerks, and employees in the Federal service and for other purposes.

Authorizing and directing the Director of the Census to collect and publish statistics of State finance.

Authorizing the Director of the Census to employ temporary clerks, etc.

Authorizing the Director of the Census to furnish certified copies of population and agricultural returns.

To amend an act of March 3, 1913, entitled "An Act to regulate the officering and manning of vessels subject to the inspection laws of the United States."

It is hoped that the above bills will be passed at the next session of Congress, as they are all important measures and in every way advisable.

At its last session, as emergency measures, Congress passed acts authorizing the transfer of the vessels and personnel of the Lighthouse Service and the Coast and Geodetic Survey of this Department to the War and Navy Departments.

#### **Underpaid Officials of the Department.**

I again emphasize the moral obligation which exists to pay the Supervising Inspector General of the Steamboat-Inspection Service and the Commissioner of Navigation salaries equal to those paid to other bureau chiefs in the Department bearing no heavier responsibilities. Congress has within the last few years greatly added to the burdens and responsibilities of these two officers. If they were fairly paid before these duties were added to them, then they are performing these added duties substantially without compensation. On page 220 of my report for 1916 I showed that a series of laws have imposed upon the Navigation Service at least double the amount of work heretofore required of it. For this added labor nothing is paid.

In Appendix C the subject of the salaries of lighthouse inspectors is treated in detail. These officers are now paid less than are others of similar technical standing and responsibility. A provision authorizing the increase of pay for these inspectors (except the third district, now paid \$3,600) to not over \$3,000 per annum was favorably reported by the Committee on Interstate and

Foreign Commerce of the House of Representatives in the Sixty-fifth Congress and by the Senate Committee on Commerce in the Sixty-fourth Congress. The item was included in the lighthouse bill as passed by the Senate in that Congress. It is not a favor that is asked for these inspectors, but justice only. Under like conditions any private employer able to do so would grant the reasonable recompense asked.

#### **Extension of Commercial Attaché Service.**

The Bureau of Foreign and Domestic Commerce will ask from Congress an increase in the number of commercial attachés. Similar request was made last year, but was not granted. The matter is one of present urgency. This is the fit time. There is a definite call for the enlargement of this work, which has been greatly successful. Delay means neither gain nor saving, but only loss. Every week in which we fail to develop sentiment abroad favorable to American products to the fullest possible extent by a sufficient working force is time wasted and opportunity lost.

The law providing clerks for attachés limits them to one in each case at a salary not to exceed \$1,500 a year. This rigid requirement is a mistake and has worked harm. More flexible authority should be given to adjust the clerical force to the actual needs. In China, for example, the commercial attaché must have one Chinese clerk as well as an American one. He can not do his work without both. In Russia, under peculiarly exigent conditions, two and at times three assistants are absolutely required if the work is to be done. There are places where \$1,500 a year is sufficient—places, perhaps, where less would serve the purpose—and there are places also (Russia is one of them) where \$1,500 a year is quite insufficient.

#### **Effect on Department of Increased Cost of Materials and Labor.**

Throughout the year the Department has been embarrassed by the high prices of all materials and of labor. Acting under a fixed appropriation with prices rapidly advancing, it has been at times impossible to maintain crews at their full force or to provide the necessary equipment for the work in the marine services of the Department. The facts will be submitted to Congress in the belief that they will recognize conditions so well and widely known and provide the means of dealing with them.



**Measures for Promoting Foreign Trade.**

The Department earnestly hopes for the passage early in the coming session of the so-called Webb bill (H. R. 2316), now pending in the Senate. This measure will have an important bearing in promoting our foreign commerce. It will strengthen one of the weakest points in our foreign trade and will give confidence to many a manufacturer and merchant to undertake foreign business from which now, for lack of the authority this measure will give, he feels himself excluded.

This country now holds the greatest reserve of gold the world has ever seen. It is a great economic prize. On it, as a secure base, rests our national, State, municipal, corporate, and private credits. Let it be seriously diminished and the volume of credits that we can give is thereby diminished also. There are but few ways in which this reserve, based on which our credits depend, can be adequately protected from economic attack. Among these methods are loans abroad, investments abroad, sales abroad, services abroad. By one or another of these methods or by combinations of them we can keep the current of exchange so flowing that our gold reserve may resist serious diminution. In so doing we conserve our power to give credit, which is to say our power to do business on a large scale. This means employment, activity, occupation. We are becoming accustomed to loans abroad. We are beginning, but as yet only beginning, to make investments abroad on any considerable scale. We are not yet rendering services abroad on a large scale, such as insurance or transportation. We must hold as fully as we can the volume of our foreign commerce intact. If we fail to take these economic movements at their true value, the result will be upon our own heads and we shall only have ourselves to blame. We may, indeed, continue as a going concern, but we can not hold a place of financial and industrial and commercial power in the world unless we keep the credit-giving power. This situation is comparatively new to Americans; it has come upon us suddenly; it has risen out of the shock of war. It is the more necessary therefore to make it plain that if we would prosper to the full we can no longer think the thoughts of former days of relative isolation. We are in the family of a financial and commercial world, and if we would keep our place and influence therein we must play our due part as one of the family.

The establishment of free ports at strategic points on our coast would be a potent factor in maintaining and extending our foreign trade. Properly placed, constructed, equipped, organized, and operated, they would add to the employment of labor and to the returns of capital. By industries and warehouses located in the free-port areas, the cost of duty on materials used in the manufacture of articles exported from those ports would be reduced, the cost of cartage might be substantially eliminated, the expense of railway transportation could be lessened. The opportunity for use of our inland waterways could be improved and goods could thus be manufactured for export on the water front in such way as to save much expense. Any who may fear that there will be difficulty in readjusting our costs to meet foreign competition after the war should become advocates of free ports, because through the establishment of industries in such ports it will be possible to save economic wastes which weigh heavily against us but which under our present system are unavoidable. The processes of manufacturing for export would be greatly simplified when they involved the use of foreign dutiable materials and the procedure under the customs law could be made more easy not only without risk of losing revenue, but with possible gain to the taxable values of the country.

#### **Tin Smelting in the United States.**

In my last annual report brief mention was made of the establishment of a tin-smelting industry in this country. It is a pleasure to report considerable progress in this industry during the past year. The American Smelting & Refining Co. hopes to be producing pig tin from Bolivian ores at the rate of 900 tons per month by December 1, 1917, and the Williams Harvey Corporation has bought land on Mill Basin, Jamaica Bay, N. Y., and is now erecting there a smelter which is expected to commence operations early in 1918, and to utilize Bolivian tin ores.

One of the most gratifying features of this new industry is the fact that the product has been found satisfactory by tin-plate mills which have heretofore used Straits tins almost exclusively. As our food supply is so dependent upon our supplies of tin plate, the advantage of utilizing tin smelted here from American ores is manifest.

**Commercial Wastes.**

It has been a pleasure throughout the year to cooperate with the Commercial Economy Board of the Council of National Defense in an effort to save commercial wastes. In this connection repeated suggestions have been made to the Department that the appointment was desirable of an officer who would be nothing else than a national "junkman." It is the view of the Department that a primary necessity for the saving of business waste is the requirement of sound and simple systems of cost accounting, and the placing of same in nearly or quite universal use.

**Future of Bureau of Foreign and Domestic Commerce.**

It is deemed a proper suggestion for the future development of the Department's work that the time may come when the Bureau of Foreign and Domestic Commerce should operate in two parts—one of foreign commerce, the other of domestic commerce—and that more than sufficient work will be found for both. In the latter work there may well be a division of business practice, which should deal with statements of accounting, to which reference has been made, and with the whole subject of business wastes. During existing war conditions it is not deemed wise to urge this matter as one of immediate, pressing importance.

Another duty of the part caring for domestic commerce would be to collect information now sadly wanted concerning the great movements of the commerce of the country.

**Development of Waterways.**

This Department is entirely in accord with the view of the Committee on Rivers and Harbors of the House of Representatives as expressed in their communication to the Secretary of War and approved by him. (See Commerce Reports of Oct. 13, 1917.) It is believed that the policy therein suggested is wise; namely, that "appropriations should not be made for the improvement of those rivers and harbors where the communities and localities are continuously unwilling to discharge their correlative duty by providing the facilities essential for the promotion of water transportation."

As the report is written an important step forward in the development of our waterways has been made by the provision through the Emergency Fleet Corporation with the cooperation and approval of this Department of a fleet of barges and towboats

for use on the upper Mississippi River for carrying coal northward and ore southward. This is effective as a war measure to relieve the enormous pressure upon our overcrowded railways and to insure consumers of coal and the industries requiring ore in the district affected a satisfactory supply of these necessary materials.

### **Promoting Commercial Use of the Waterways.**

Through the cooperation of the New Orleans Association of Commerce, Walter Parker, its general manager, was in June made Assistant to the Secretary of Commerce for Inland Water Transportation, and in this capacity has made an extensive investigation of the problem of water transportation in the interior of the country.

Mr. Parker has visited many of the more important trade centers of the Mississippi, Ohio, Missouri, Tennessee, Alabama, and Warrior Rivers and of the Great Lakes region, meeting the business men and shippers.

In so doing, Mr. Parker pointed out three distinct periods of transportation economy:

1. The period of boat monopoly, in which commerce developed only along the waterways. During this period intense individualistic endeavor resulted in costly competition among the boat lines, but, as no convenient and economic system of terminal and storage facilities was built, the boats in many cases fell an easy prey to railroad competition in the second era.

2. The period of railroad development. In this period rapid railroad construction, at a time when the greater part of the Nation's commerce was to be found only along the waterways, resulted in a forced fight for existence between the railroads, which built convenient and economic terminal equipment on the one hand and the boats, which did nothing to better their economic equipment, on the other. The railroads won. A second step, which insured the drying up of boat traffic in many streams, was the inauguration of a railroad rate-making system which gave river towns lower rates than nonriver towns were given.

3. The period of joint river and rail transportation. In this period, which is now beginning, the use of the boats is forced through the necessity of augmenting rail transportation. There is now more commerce requiring movement than there are facilities for moving it. Consequently, the original incentive for the establishment of preferential railroad rates to river towns is largely eliminated. Recent rate readjustments at river towns clearly

indicate a tendency toward the withdrawal of such preferential rates. In other words, potential navigation and an occasional boat can no longer be used merely as clubs with which to force down railroad rates. In this period transportation economy requires the use of the traffic lines of least resistance. This means coordination of all means of transportation, and the building of terminal and storage facilities with that end in view.

Many water-served cities are now either building such facilities or are preparing to do so.

Business men generally are now awake to the necessity for the use of the waterways as an adjunct to the railroads, and are co-operating to that end. They realize as never before that, after the war, competition for foreign markets will make necessary the employment of every means of transportation if American costs of movement to and from shipside are to be reduced to as favorable a parity as possible with such costs in Europe.

It is a part of this same problem to find the most effective use for the electric railway and the motor truck as adjuncts to the railway in a united cooperation for the general good. None of these instrumentalities can be ignored. Each has its own place in the problem and the place of each is a helpful and not a hurtful place. The railroads need relief to-day from much heavy bulk freight which waterways can well be made to carry. They need relief also from much short-haul traffic in the immediate neighborhood of large centers. This the motor truck and the electric railway can handle. It is inevitable that we shall come to co-operation in this matter. The sooner the better for us all.

#### **Conference to Provide for the Proper Manning of Merchant Vessels.**

On June 29, 1917, the Secretary of Commerce and the Secretary of Labor issued a joint call for a conference between officials of said Departments, officials of the United States Shipping Board, and representatives of the shipowners and seamen, respectively, of the Atlantic, Pacific, Gulf, and Great Lakes. The communication calling this conference read as follows:

DEPARTMENT OF LABOR,  
OFFICE OF THE SECRETARY,  
*Washington, June 29, 1917.*

DEAR SIR: The existence of a state of war has created abnormal conditions at sea, seriously affecting the supply of seamen and the proper manning of vessels. The contemplated building of large numbers of additional vessels and the manning of the same when afloat will make the problem more acute. A sufficient supply of seamen for the merchant vessels of our allies, as well as for American merchant vessels, is essential to

the proper conduct of the war. The establishment of harmonious relations between seamen and shipowners and the removal of all obstacles, real or imaginary, that stand in the way of retaining the present force of seamen, and adding to the number as necessity may require, would be of immense value to the country in the present emergency.

For these reasons, you or such persons as the organization you represent may select are respectfully invited to attend a conference to be held in the office of the Secretary of Labor in Washington, D. C., on Wednesday, July 18, 1917, at 10 o'clock a. m., at which representatives of the Department of State, the Department of Commerce, the Department of Labor, the Shipping Board, the shipowners and the seamen of the Atlantic, Pacific, Gulf, and Great Lakes are invited to be present for the purpose of considering the whole subject of the training and supply of the necessary seamen for the merchant vessels of the United States and its allies trading in American ports, and all questions affecting the same.

Sincerely yours,

WILLIAM C. REDFIELD,  
*Secretary of Commerce.*  
W. B. WILSON,  
*Secretary of Labor.*

The conference was held in the auditorium of the Department of the Interior on Wednesday and Thursday, August 1 and 2, 1917, when the subject of the call and numerous related subjects were discussed.

The result was the appointment of a committee, six members of which represented the employing shipowners, six members the interested organizations of employees, one member the Department of Commerce, one the Department of Labor, and one the Shipping Board.

The committee met August 8. The membership was as follows:

Representing the shipowner employers: P. A. S. Franklin, president International Mercantile Marine Co.; H. H. Raymond, president Clyde & Mallory Steamship Lines; Frank C. Munson, president Munson Steamship Line; Ernest M. Bull, vice president A. H. Bull & Co.; David T. Warden, manager marine department, Standard Oil Co.; L. H. Shearman, vice president W. R. Grace & Co.

Representing the organized seafaring employees: Andrew Furu-  
seth, president International Seamen's Union of America; William S. Brown, of the Marine Engineers Beneficial Association; Ulster Davis, of the American Association of Masters, Mates, and Pilots; William A. Wescott, of the Masters and Mates of the Pacific Coast; H. P. Griffin, of the Marine Cooks and Stewards Association; Thomas Conway, of the Firemen's Division of the International Seamen's Union.

Representing the Department of Commerce: George Uhler, Supervising Inspector General, Steamboat-Inspection Service.

Representing the Department of Labor: A. Warner Parker, law officer, Bureau of Immigration.

Representing the Shipping Board: R. B. Stevens, vice chairman of the Board.

The committee adopted the following memorandum:

The conference between the Shipping Board, the committee on shipping of the Council of National Defense, and representatives of the International Seamen's Union was called to order at 9.30 p. m. on May 8, 1917. Chairman Denman of the Shipping Board was in the chair. Those present in addition were Vice Chairman Brent, Mr. White, and Mr. Stevens of the Shipping Board; Mr. Raymond, of the Atlantic, Gulf & West Indies Steamship Lines; P. A. S. Franklin, of the International Mercantile Marine; Mr. Munson, of the Munson Line; Mr. Bull, of the Bull Line; Mr. Sherman, of the Grace Line; Mr. Warden, of the Standard Oil Co.; Commissioner Chamberlain, of the Bureau of Navigation. Representing the organized seamen, President Furuseth of the International Seamen's Union, H. P. Griffin, G. H. Brown, Oscar Carlson, Dan Ingraham, and P. J. Pryor.

A general synopsis of the conference was as follows:

The representatives of the steamship lines and of the organized seamen agreed with the Shipping Board that some action ought to be taken looking to an increase in the number of seamen in order to furnish men for the vessels trading to England and France carrying supplies, and to yet continue an uninterrupted coastwise trade.

To attain this purpose the representatives of the shipping lines, in cooperation with the Shipping Board and the organized seamen, tentatively agreed to cooperate for the attainment of this end in the following manner:

Substantially all the steamship lines will agree to pay the following wage: Sailors and firemen, \$60 per month; coal passers, \$50 per month; oilers and water tenders, \$65 per month; boatswains, \$70 per month; carpenters, \$75 per month; *overtime pay for cargo work 50 cents, for ship work 40 cents per hour.* Bonus going to the war zone, 50 per cent of the wages; wages and bonus to continue until crew arrive back in the United States; \$100 compensation for loss of effects caused by war conditions. *The scale of wages and bonus for cooks and stewards at present in force be maintained and continued during the continuance of this agreement.*

That a certain number of boys, determined by the number of men carried, are to be employed in addition to the usual crew; that a number of ordinary seamen will be employed in proportion to the able seamen carried; taken as an instance, a vessel now carrying 8 men on deck will carry 6 able seamen, 2 ordinary seamen, and 2 boys, such boys and ordinary seamen to have ample opportunity to learn the work usually demanded of able seamen.

That the representatives of the organized seamen shall have access to and be permitted on docks and vessels during reasonable hours.

The representatives of the seamen tentatively agree to join with the shipowners in an appeal to seamen now employed on shore to come back to the sea.

That the bonus and other conditions arising from the war shall terminate with the war and that the wages set shall remain for one year, to the end that wages be stabilized and that the men now on shore may be induced to return to the sea.

That the seamen will use earnest efforts in cooperation with the officers to teach seamanship to the boys and ordinary seamen.

That the representatives of the organized seamen reported that this agreement had been put to vote of their unions and ratified by their membership.

That this agreement is hereby ratified and confirmed on this 8th day of August, 1917.

This memorandum was ratified by the signatures of representatives of the shipowner employers and the representatives of seamen's organizations and was countersigned by the vice chairman of the Shipping Board, the Secretary of Commerce, and the Secretary of Labor.

The agreement reached by the shipowners and the seamen as above is the basis of current commercial action and employment and it is upon a similar basis that the estimates of the department for employing seamen in its marine services during the coming fiscal year have been made.



## BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

(BURWELL S. CUTLER, *Chief.*)

Since the close of the fiscal year a number of events have taken place in the Bureau of Foreign and Domestic Commerce that ought to be mentioned here to give a correct idea of the conditions under which that service entered upon the work of the present year.

Dr. E. E. Pratt resigned from the position of Chief of the Bureau on July 17, 1917, and his place was immediately filled by the appointment of Burwell S. Cutler, a practical manufacturer and exporter of Buffalo, N. Y., as Acting Chief. Mr. Cutler had for some time been serving as First Assistant Chief, a position made vacant when E. A. Brand was dispatched to South America on a special mission. Early in October Mr. Cutler was nominated by the President as Chief of the service, which nomination was confirmed by the Senate on October 5, 1917. In October, 1917, after returning from South America, Mr. Brand resigned from the Government service to become secretary of a commercial organization.

In view of the unprecedented cost of travel in Russia and the disturbed conditions there, a number of commercial and economic investigations planned in that country have been postponed. Several commercial agents, whose original plans called for a tour of Russia after they had completed their studies in the Far East, have been withdrawn or directed to other fields.

A report entitled "German Foreign-Trade Organization" has been issued since the close of the fiscal year, and the unusual demand for it bears witness to its timeliness. It is the work of C. D. Snow, Assistant Chief of the Bureau, who was engaged upon an industrial investigation in Germany when the war started.

The fiscal year 1917 was the most eventful in the history of the Bureau of Foreign and Domestic Commerce. For the greater part of the 12 months it was concerned as usual with promoting the sale of American goods and with statistical and other studies of the country's trade. With the passing of each month the volume of foreign trade rose to previously unheard-of proportions, and the problems arising out of the country's neutral position and foreign restrictions on trade became more numerous and perplexing.

While much of our increased exports was going to the European belligerents, there was a steady increase also in our sales to countries without the fighting zone, and the Bureau, realizing the importance of new permanent trade, devoted itself particularly to assisting American exporters in gaining and retaining new business in such districts as South America and the Far East. Many additional expert agents were engaged to investigate conditions in these regions and the information so obtained was distributed with the least possible delay. Commercial attachés concentrated their attention on the larger problems relating to the winning of markets in their districts and the retention and development of such markets when normal conditions return. The consular service, though burdened with extra tasks resulting from the war, contributed substantially to the Bureau's stock of commercial information. Returned agents, commercial attachés, and consuls toured our manufacturing and shipping centers, addressing meetings of business men and imparting information through personal interviews. The Bureau at Washington and its various district and cooperative offices redoubled their efforts to distribute information through the printed page, through correspondence, and through interviews. It was the busiest period in the Bureau's history.

Then came the declaration that a state of war existed between this country and Germany, and the Bureau was required immediately, not to stop its usual activities, but to add to them new undertakings aimed at coordinating certain phases of the Nation's business activities, and especially its foreign-trade activities, with the Government's plans for prosecuting the war.

#### **Organization for Licensing Exports.**

The sudden entry of the Bureau into the field of special war work near the close of the fiscal year meant a radical departure from the specialized work to which the staff was accustomed. The service was confronted with novel tasks of great importance.

These war tasks included the organization of a division to license such exports as were to be regulated; the drafting of legislation required to deal effectually with enemy trade, as well as the preliminary steps toward the organization of the necessary machinery for administering such legislation when passed; and finally, the creation of a section of cost accounting for the immediate purpose of assisting the branches of the Government interested in costs in connection with war contracts. Each of these

three undertakings involved a tremendous amount of hard and intelligent work. They involved rapid work, also, and because the time was limited and the necessity for action urgent, the responsibility was assumed for getting the work under way. The Department was familiar with the experiences of other countries along the same lines and felt that its own experience in promoting trade would be an advantage. It was realized that eventually the work might be turned over to special war-work organizations, but there was the fullest confidence that the Bureau could successfully initiate the new work and if necessary carry it to a successful conclusion.

Perhaps the most important task with which the Bureau was thus confronted was that of licensing exports. When the United States entered the war, it was inevitable that steps would be taken to control our exports in such a way as to conserve our own supplies, make the best use of available tonnage, and prevent American supplies from reaching the enemy.

Authority for such procedure was given in the espionage act, which became effective June 15, 1917, and on June 22 an Executive order was issued creating the machinery to formulate export policies and put them into effect. The work of making recommendations to the President was assigned to an Exports Council composed of the Secretary of State, the Secretary of Agriculture, the Secretary of Commerce, and the food administrator. To the Secretary of Commerce was assigned the duty of administering this feature of the espionage act. At the close of the fiscal year it was anticipated that presidential proclamations would shortly be issued imposing license requirements on certain commodities and designating the countries to which exports of such commodities would require licenses.

The issuing of licenses was intrusted to the Bureau of Foreign and Domestic Commerce, and there was formed within that Bureau a division known as the Division of Export Licenses. The Bureau had been instructed to go ahead in ample time to plan the organization of the division for the work, after a careful study of similar work that had been done by the allied Governments. Information of a valuable character was obtained from certain sections of the allied missions which at the time were in this country. It was imperative that the work should start with as little disruption of the export trade as possible. A distinct opportunity was presented to foster American foreign commerce by

planning the mechanism of export licensing in an office whose sole concern is to promote commerce. A staff was soon actually at work, thanks largely to the patriotic spirit that prompted a number of experienced American export men and economists to give up their own work and accept service in the Bureau. There was no special appropriation available for any such preliminary steps. All was accomplished by much overtime work and hard work by the permanent staff and by help given by outsiders, the expense being borne by the regular Bureau funds.

Within the new Division of Export Licenses a war trade intelligence section was formed to collect data as to the character of shippers and consignees. A war trade statistical section was also organized, the duties of which consisted broadly in analyzing international trade in commodities having war significance. For the difficult work of passing on individual applications for licenses to export, a corps of trade experts was selected, each man qualified by experience in the export trade in some particular commodity, such as coal or steel, or to have a practical knowledge of the foreign trade of some one country or district. The usual administrative aids were fully prepared.

A large number of clerks was needed for a division of such dimensions, and these were furnished as rapidly as possible by the Civil Service Commission. It was impossible to install a sufficient force for this work in the Commerce Building, which has been overcrowded almost from the beginning, so the building at 1435 K Street was rented and rearranged to accommodate the rapidly increasing staff.

For the convenience of the various exporting centers, as well as of the Washington office, the district offices of the Bureau were called upon to help in this work. From the beginning it was held proper that the agents in charge of the district offices receive applications from exporters in their districts and obtain decisions with the least possible delay from the Washington office. This meant that an immense amount of extra work would fall to the lot of the offices early in the new fiscal year, but preparations to meet such an emergency were begun in the same cheerful spirit that had characterized the staff at Washington, each employee assuming the attitude that he was "doing his bit" to help win the war. This soon overcame the initial difficulties.

At the beginning of the new fiscal year, therefore, the Bureau was well equipped to handle the novel and arduous task of passing

upon applications for licenses to export many of the most important products shipped from American ports.

The machinery organized for the above work was turned over to the Exports Administrative Board (later designated the War Trade Board) in August in accordance with Executive order.

The task of drafting legislation to limit trading with the enemy was one to which the Bureau staff was well able to contribute, owing to its own experience in international trade and its familiarity with steps taken in the same direction by the Governments of the European belligerents. Much careful original study and the closest attention to details on the part of especially qualified experts in trade and in law were required, to say nothing of the careful planning of an organization capable of administering the trading with the enemy act when once passed.

In the Bureau of Foreign and Domestic Commerce a definite organization for the administration of the act and the various forms which would be necessary under the act were mapped out. The preliminary work thus done under severe pressure has been of great importance in preparing the way to enforce the act. The Bureau, from its close contact with manufacturers, merchants, and financial institutions, was also able to give expert and sympathetic counsel on matters relating to the administration of enemy property within the United States. This work also has been turned over to the War Trade Board by Executive order.

In organizing a section of cost accounting, the Bureau took over similar work transferred to it by the Federal Trade Commission. As carried on up to that time, it was chiefly educational work that had come into existence as the result of a widespread demand in the business community for more uniform methods of accounting.

Circumstances made it advisable to concentrate at the outset upon rendering such assistance as might be needed by other branches of the Government interested in costs in connection with war contracts. The first thing done, therefore, was to call a conference of representatives from the various departments of the Government to present an outline of the scope of the division. According to this outline the work planned was as follows:

1. To establish a consultation service on costs and to assist in any way such departments as may be interested in costs.
2. To arrange meetings with manufacturers who are interested in Government contracts on the cost-plus-profit plan for the

purpose of explaining to them the methods to be followed in presenting their costs to the Government.

3. To carry on the educational work formerly conducted by the Federal Trade Commission.

The next work undertaken was the formation of an Inter-departmental Cost Conference under the direction of the Secretary of Commerce and the Assistant Chief of the Bureau. This conference set for its task the adoption of uniform methods of cost in relation to Government contracts and also uniformity of form of contracts. In addition to the Department of Commerce there were represented on this conference the War Department, the Navy Department, the Food Commission, the Council of National Defense, and the Federal Trade Commission. It is interesting to note that the conference invited the controllers of leading American concerns to appear at the meetings and express their views. This is thought to be the first time that this or any other Government ever tried such a plan in exactly similar circumstances. These conferences were called to collaborate in the preparation of a manual on cost methods and contract forms covering all contractual relations on Government purchases.

The section was placed in charge of an expert, approved by the American Institute of Accountants, who was provided with a staff of five assistants. The importance of scientific cost methods was graphically demonstrated by E. N. Hurley while he was a member of the Federal Trade Commission and is recognized by every progressive and forward-looking member of the business community.

The above section was transferred to the Federal Trade Commission early in the new fiscal year, as they were active in related work under Executive order.

#### **Raw Materials from Russia.**

The importation of raw materials from Russia under the agreement of September 23, 1915, between the Russian Government and the United States Government has been one of the important activities under the supervision of the Department. Under this agreement applications for permits to bring goods out of Russia were filed with an agent of the Bureau of Foreign and Domestic Commerce, acting as a special representative of the Secretary of Commerce, in New York. When application had been made in due form, it was approved by the Russian authorities in this country and then taken up with the Government officials in Russia. The

total of applications filed by American firms for various classes of commodities was about \$30,000,000; permission has been granted by the Russian Government for the exportation of approximately \$16,000,000 worth of material; and nearly \$9,000,000 worth of such material has actually been released by the special representative of the Secretary of Commerce. Applications were given in prescribed form in order to present all the facts required by the Russian Government, and payment for commodities released was effected in a manner prescribed by the Russian Government. A disposition has been shown by the Russian authorities to allow as large an amount of Russian materials as possible to come to the United States, but not all applications made by American firms could be granted, as substantial quantities of the desired materials were needed for war purposes within Russia. Up to this date the Russian Government has refused to allow the exportation, with a very few exceptions, of calfskins, goatskins, sheepskins, flax, and wool.

#### **Raw Materials from Other Countries.**

In this connection it should be pointed out that the Department has also been able to provide material assistance to many American manufacturers depending on foreign countries other than Russia for their supplies of raw materials. The Department has proffered its good offices in a number of cases and has been able to render very vital service to the American industries affected. This function, however, was, after the close of the fiscal year, transferred under Executive order to the War Trade Board.

#### **Bureau Helps to Conserve Perishable Foods.**

In March, 1917, the National Cannery Association brought to the attention of the Department the inability of canners throughout the country to obtain assurances that they would be able to get a supply of cans or tin plate from which to make the cans sufficient to take care of the crops expected as a result of the efforts to increase the food supply. Thereupon resulted, chiefly through the efforts of the Bureau of Foreign and Domestic Commerce, a campaign unprecedented in character, which had for its chief aim the diversion, for a limited period, of practically all available tin plate and cans to the packing of perishable foods.

Upon investigation by the Bureau, it was found that can makers were demanding from manufacturers of tin plate an increase of one-third over their consumption of tin plate in 1916, a record year, while the plate mills were having difficulty in

running to capacity, owing to difficulties in obtaining sheet bars from the steel mills and to lack of sufficient care to keep them supplied with raw materials and to take away the finished product in time to cope with limited warehouse space. There were also labor difficulties in some plants.

At the request of the Department, a committee was formed, now known as the Tin-Plate Conservation Committee, consisting of representatives of the tin-plate industry, the can-making industry, the canners, and the wholesale grocers, and in addition the Chief of the Bureau of Chemistry of the Department of Agriculture, and the Chief of the Bureau of Foreign and Domestic Commerce.

This committee met at the Bureau from time to time during the summer and made certain recommendations for the approval of the Secretaries of Agriculture and Commerce, the most salient of which was the one which resulted in tin-plate manufacturers and can makers, voluntarily and with the consent of canners and wholesale grocers, preferring in their shipments packers of perishable foodstuffs. This preference was in effect for a period of some 90 days, or until the perishable crops were well in hand.

In addition to diverting plate to the perishable foodstuffs, the production of tin plate was stimulated by arrangements which resulted in most of the mills running an additional turn each week and by provision for an adequate supply of sheet bars and transportation facilities. The cooperation of the steel mills and of the war board of the American Railway Association was necessary for this, and the work of the latter organization played no small part in the successful completion of the task. Producers' exports of tin plate were also curtailed.

To have asked packers of nonperishable articles to cease using cans made of tin plate and not to have taken steps to provide them with substitute containers would have been unfortunate. Immediately, therefore, the tin-plate situation and the gravity thereof being known, the Bureau set about in conjunction with the Bureau of Standards, to develop a substitute container adapted for commercial use. It was found that there were already on the market canisters or cans made of paper or fiber that had been successfully utilized for the packing of some articles of food. Various types of these were subjected to tests by the Bureau of Standards, and subsequently a pamphlet illustrating their possibilities as substitutes for tin cans was prepared jointly by both



Bureaus and issued gratis by the Bureau of Foreign and Domestic Commerce. This pamphlet was widely reprinted throughout the country, and thousands of copies of a list of manufacturers of the paper or fiber cans were sent to inquirers.

The possibility of utilizing once-used tin cans was also investigated, but it was found advisable to encourage only the subjection of used cans to "detinning" processes, whereby most of the steel and tin are recovered from the cans in forms suitable for further use in manufacture. The expansion of this industry is now being considered by various commercial organizations throughout the country, and a material increase in the conservation of tin and steel is foreseen.

The attention of the British authorities was called to the decrease in the imports of pig tin, and they were requested to facilitate larger shipments of that material to this country and if possible to divert the transportation of it to the Pacific route. Careful touch was also kept with the progress of our domestic tin-smelting industry, to which reference has already been made.

#### **Assistance to Railroads War Board.**

At the request of the Commission on Car Service, which was of so great service to the Department in its tin-plate conservation work, an effort was made to secure the more efficient use of freight-carrying equipment in the country through the cooperation of trade organizations with which we are always in contact. Suggestions as to how the car shortage could be reduced were prepared in the Bureau of Foreign and Domestic Commerce and sent out broadcast. Commercial organizations were urged to inaugurate intensive campaigns in their localities, and it is known that considerable relief was given.

#### **Definite Results of Trade-Promotion Work.**

Much of the work of the Bureau is necessarily of such a character that actual transactions can not be traced directly to it. Many large transactions take place through the Bureau's good offices which can not be set forth without revealing trade confidences. The activities of the Bureau are, however, admittedly responsible for actual orders in American goods, for profitable connections with foreign business houses, and for the satisfactory settlement of disputes that will arise in spite of the wisest precautions. The following are a number of unsolicited appreciations from firms which have benefited directly from the Bureau's service.

### This from an exporter on the Pacific coast:

As export manager of my firm, it has been part of my work to keep in close touch with the consuls in the various cities throughout the world with the object of securing reliable firms to act as our representatives, and though the consuls accept no responsibility in referring these people to us, it affords us great pleasure to state that each of our representatives has proved to be a most reliable and energetic business man.

A New York exporter enumerates the following direct results of the foreign-trade opportunity service rendered by the Bureau:

An electrical house in Manchester, England, has placed with us orders amounting to \$25,000.

A good connection has been made with a concern in Glasgow for heavy hardware.

Automobile tires have been sold in India, Philippine Islands, Malay Peninsula, Siam, and Sumatra.

Orders for hosiery received from Copenhagen, Lisbon, Vladivostok, Johannesburg, and Auckland.

Other lines sold in British Guiana, British Honduras, Porto Rico, and other territories in the West Indies.

A Chicago firm writes as follows:

As a result of an "Opportunity," published some time ago, we have received a contract to supply a Chilean house a large order and to furnish them military ornaments and other articles of our manufacture.

Another Chicago house acknowledges its indebtedness to the Chicago office in the following manner:

You will recall that about one month ago you called me over the telephone and asked me if I was interested in giving a quotation on 60 typewriters, Spanish keyboard, to a firm in Peru. I am pleased to report that I have been able to secure the order in question, which amounts to a little over \$3,000. I will say once more that we have found that several of our best customers have been secured through the names furnished us by the Bureau of Foreign and Domestic Commerce.

It has been ascertained that the work of Special Agent Ralph M. Odell has resulted directly and indirectly in sales of cotton goods amounting to \$1,500,000 and sales of cotton mills and machinery amounting to \$2,000,000 during the last three years. This is a conservative reckoning. The gain to American business resulting from this single investigation, therefore, amounts to several times the entire expenses of the Bureau of Foreign and Domestic Commerce for those three years.

The following letter has been received from an Australian buyer who recently visited this country:

Owing to the assistance rendered to me by your Department, I have been successful in securing the agency for Australasia for the largest shoe manufacturer in the United States. Also a large cotton mill and a manufacturer of clothing. I feel confident that without your assistance I should not have been so successful.

The commercial agent in charge of the New York office cites the following interesting example of the definite results that sometimes follow the Bureau's efforts:

The sales manager of a piano company has recently been able to close a deal appointing an agent in Copenhagen for the general representation of his company, which included a preliminary order for 100 pianos to be shipped immediately to Copenhagen. This resulted directly from Consul General Winslow's recent visit to our office.

A firm of importers in the far-off Dutch East Indies, after trying long and hard to place large contracts in this country for desks, finally succeeded with our cooperation. This firm expresses its appreciation as follows:

We feel obliged to express our sincere thanks to the Bureau of Foreign and Domestic Commerce for the aid given us in our search for the right manufacturer, and especially to the Chicago office of the Bureau, which has assisted us a great deal in obtaining what we wanted. We appreciate the good work of the Bureau very much.

### **Does the Bureau's Work Really Influence American Trade?**

There is no disputing the fact that the Bureau of Foreign and Domestic Commerce has been directly responsible for the sale of many hundred thousand dollars' worth of American goods in foreign markets, but aside from the specific opportunities for sale brought to light by its representatives, does it have an appreciable affect upon the broader policies that lie behind the foreign commerce of the country? Are the preliminary surveys of commercial conditions in foreign countries considered as seriously by the manufacturer and exporter as the Bureau would like to have them considered?

These questions can be answered much more definitely now than they could have been a few years ago. It is possible now, for instance, to estimate the effect of the Bureau's long campaign for better packing in our export trade. Our own representatives, as well as the representatives of private business concerns, seem agreed that complaint on the score of poor American packing is dying out. The foreign importer no longer begins and ends his interviews with our representatives by condemning all American houses as poor packers. He may still find fault at times, but as a rule he is willing to admit that we are learning the lesson. Special Agent Halsey quotes a prominent South American importer as saying that "Many American houses now pack their goods as well as anybody. The American is sometimes hard to convince, but once convinced there is no one in the world more adaptable." The Bureau, of course, does not claim all the credit for this result,

but it does feel justified in assuming that its long and persistent campaign has had appreciable results.

The increased importance attached to our preliminary surveys has been commented on often of late by the older special agents in the service. Some of these men can recall visits to well-known concerns a few years ago when it was necessary to explain what the Bureau was, what it was driving at, and what the duties of special agents were. Now they frequently find their own reports on the desks of officials of such concerns when they call. There is no longer any need of preliminary explanations. They can get down to business at once. A great many representatives of private concerns have been met with on foreign soil during the year who had special agents' reports in their bags.

It will never be possible to estimate how many dollars' worth of business results from consulting these special reports, but their general use seems to indicate an appreciation of their value. It is a fine and stimulating thing for the members of the staff.

#### **Extension of the Civil Service in the Bureau.**

Continued efforts were made during the year to improve the personnel of the Bureau of Foreign and Domestic Commerce in the Washington office and in the field. A very important step in this direction was the transfer to the civil service, by Executive order, of the positions of trade commissioner, commercial agent, expert, and special agent. This change was adopted after careful consideration on the ground that it would give stability and definiteness to these positions and that it would assure the appointment of men who had proved their qualifications. In practice the change has worked satisfactorily, owing largely to the wholehearted support and cooperation of the Civil Service Commission.

Since the transfer of these positions from Schedule A to Schedule B, the Civil Service Commission has conducted 13 special examinations, in which 402 candidates participated, and of whom 81 received passing marks and 19 received appointments. During the fiscal year and prior to the transfer, two examinations were conducted by the Bureau in which 111 candidates participated. The total number of persons called to Washington for the oral examination was 60.

The system of handling all appointments matters by an "appointments committee" has been found satisfactory. This committee is composed of men from several offices of the Bureau who make recommendations to the Chief regarding all appointments matters.

It weighs carefully the comparative merits of the employees, considers their grievances, and renders decisions or recommendations which preclude the error of such partiality as an individual might unintentionally exercise if depending upon his lone judgment.

The work of the committee embraces (1) the fixing of examination dates, (2) the proposal of qualifications for examination and the examination questions, and (3) advertisement of the examinations and consultation with those people most likely to know of suitable candidates. The duties were especially heavy during the year, and toward the latter part of it considerable additional and highly successful work was done in locating in advance possible members of a staff to handle the work of the control of exports.

#### **Commercial Attaché Service.**

Testimony offered by American business men at home and abroad and by our diplomatic representatives gives assurance that the commercial attaché service is amply fulfilling its mission.

The results attained during the three years since the commercial attaché service was established call for its extension. At present certain large and important markets for American products are scantily covered. Some sections are not covered at all. During the last year, urgent requests for the establishment of new commercial attaché posts have been received from our ambassadors to Italy, Japan, Spain, and Mexico, and from the consul general at Calcutta, India, the request from Japan having already been acceded to. In addition, we should have these representatives in Central America, South Africa, the East Indies, Venezuela, Colombia, and the West Indies, and, when events shall permit, in Scandinavia and the eastern Mediterranean. Otherwise, our touch with the economic conditions now in process of world-wide readjustment will be inadequate for our national needs.

American business men who have come in contact with the commercial attachés in the course of their travels express their high valuation of the assistance given by the attachés. Manufacturers and exporters have been unanimous in expressing their gratitude of the benefit derived by the reports and the other advices through this service. The work done by the commercial attaché is distinctive; it does not involve duplication of work performed abroad by the consular service or by our own traveling agents.

It may be interesting in this connection to note that New South Wales expends about \$30,000 per annum in maintaining its trade commissioner in the United States. He is paid a salary one-half

more than the United States pays to its commercial attachés abroad. He is supplied with two clerks, a messenger, and an inspector and has, in addition, a deputy commissioner with a messenger located in New York. The details appear in the debates of the Parliament of New South Wales for December 4, 1916.

A feature of the service during the last year was the special and supplementary investigations carried on along the lines successfully followed the previous year in investigating the world markets for American hardware. Among the new investigations was that of the South American markets for American wearing apparel. Each attaché was allotted funds for the employment of an expert to prepare under his supervision the report on the local markets. Funds were also provided for the purchase of a large number of samples. The investigation was nearing completion at the close of the fiscal year. The samples, together with the current information as to prices, sizes, qualities, etc., will be made available to American manufacturers at the sample exhibit room in New York and then throughout the country.

Another South American investigation conducted by the attachés concerned the possibilities of extending American fire insurance business on that continent. This study was made at the request of the National Board of Fire Underwriters, whose membership includes most of the important companies writing fire insurance in this country. On the data provided through the commercial attachés, American fire insurance companies will be in a position to decide on the desirability of entering these foreign fields.

One of the most far-reaching studies yet undertaken through the attaché service relates to the establishment of American banks abroad and the investment of American capital. Our banks are now doing good work in the foreign field, and we are glad to assist them in expansion for the benefit of American commerce. Linked with the subject of banking appears that of investment by American capital in foreign properties, such as railroads, mines, public utilities, etc. In order to furnish American investors with the necessary preliminary data concerning fields needing development, the attachés make a continuing study of their particular districts.

It was possible this year to bring several of the attachés back to this country. Such a trip serves two purposes: First, it enables American manufacturers and exporters to receive at first-hand the benefit of the attaché's experience and observations; second, it enables the attaché to acquire a fresh view of commercial condi-

tions in this country and to ascertain how he can best serve the needs of American business men.

The most extensive trip was that of Commercial Attaché Julian Arnold at Peking. Mr. Arnold left his post in September and returned to Peking in May, after a trip which included every section of the United States. Commercial Attaché Erwin W. Thompson, temporarily at The Hague, was absent from his post on duty from August until February. Commercial Attaché Albert Hale left Buenos Aires in August and was in Washington until his resignation in December. Commercial Attaché Pierce C. Williams, assigned to London, spent several months during the fiscal year in the United States advising on matters of commercial policy and practice connected with the war. Soon after the close of the fiscal year Commercial Attaché Philip B. Kennedy was transferred from Melbourne to London and Mr. Williams, because of illness in his family, returned to the United States. Commercial Attaché Verne L. Havens at Santiago arrived here in February and remained until the end of the fiscal year, when he resigned to take up private employment.

#### **Commercial Attaché Assigned to Japan.**

After giving the matter careful consideration, a commercial attaché has been assigned to Japan. To make this long-desired move possible, one of the offices on the west coast of South America was closed, the work there now falling to the attaché at Lima, Peru, and the attaché at Buenos Aires.

In April, 1917, Dr. Frank R. Rutter, formerly Assistant Chief of the Bureau, was appointed to fill the new post at Tokyo. After spending some time visiting industrial centers in this country, Dr. Rutter sailed for Japan in early June. It is believed that the present arrangement will prove a benefit to our commercial interests and that the appropriation made by Congress will be used to the best advantage in this manner.

#### **Work in Europe.**

In London war conditions rendered it impracticable to do extensive promotive work. The commercial attaché kept the Bureau fully advised as to the various changes affecting our trade. His office was able to assist our business men materially with reference to British import and export regulations. The attaché made a thorough study of England's war-trade organization which proved to be of special value. Upon the outbreak of the war he was of great assistance, because of his knowledge of

the English system, in drafting the plans for our Government's war-trade activities. When this work was well under way, he returned to his post in order to view further the interallied economic activities in London.

Commercial Attaché William C. Huntington, at Petrograd, made an extensive tour of European Russia. His knowledge of the Russian language enabled the attaché to render invaluable assistance to the American ambassador during the trying days of the Russian revolution. The year was largely devoted to the study of Russian commercial conditions, during which time he also cultivated many useful points of contact.

Although Commercial Attaché C. W. A. Veditz, at Paris, has been subject to war conditions, he has been able, nevertheless, to do much trade-promotion work along the line of prohibited French imports. He was successful in inducing the French Government to permit a large Dutch-American machinery house, which represented about 60 of the leading industrial machinery makers of this country, to continue its operations in France. This achievement saved a large volume of business annually for American manufacturers. Mr. Veditz has been keeping in close touch with the reconstruction problem which France must face after the war and in order to get first-hand information has visited, through the courtesy of English and French officials, the devastated regions in northern France and in Belgium. Just before the close of the year the attaché was designated by the American ambassador to appear for the embassy at important interallied conferences and committees.

Commercial Attaché Erwin W. Thompson continued to make his headquarters at The Hague till February, 1917, since when he has been located at Copenhagen. He was originally assigned to Berlin. Besides making a study of the opportunities in Denmark for the establishment of American banks, Mr. Thompson was instructed to keep the Bureau in touch with commercial conditions throughout Scandinavia. During his visit to this country he gave valuable aid to the California olive industry upon which subject he is an expert.

#### **Work in South America.**

Commercial Attaché Albert Hale, assigned to Buenos Aires, returned to the United States in August, 1916, and after visiting the principal centers interested in trade with Argentina, resigned from the service. Lew B. Clark, the clerk at that post, has been,



in charge of the office during the absence of the attaché, besides conducting the wearing-apparel investigation and attending to the purchase of the general samples. Mr. Clark has kept the Bureau informed of important trade changes in his territory. Plans are under consideration for filling this important post at an early date.

Commercial Attaché William C. Downs, at Rio de Janeiro, while making the special investigations already referred to, has been engaged in a close study of Brazilian finances. The attaché forwarded several valuable reports on investment opportunities, one of which, a loan of \$5,000,000, was floated successfully in this country. In September, 1917, Mr. Downs returned to the United States for the first time in nearly three years.

Commercial Attaché William F. Montavon, at Lima, found conditions in his district very favorable for trade promotion, and as a result of the attaché's activities, initial shipments of several classes of American merchandise were made to Peru. While in Bolivia Mr. Montavon made a study of the possibility of the Bolivian Government securing its railroad supplies and equipment from the United States. As a result, substantial purchases were made from American manufacturers for the first time. Mr. Montavon has also been investigating Peruvian fibers, with the cooperation of our Department of Agriculture. It is hoped that these investigations will eventually lead to the sale of American machinery on a large scale.

Commercial Attaché Verne L. Havens at Santiago was instrumental in having the American Society establish a commercial section for the furtherance of trade relations between Chile and the United States.

#### **Work in the Far East and Australia.**

During Commercial Attaché Arnold's visit to the United States the office at Peking was in charge of John R. Arnold of the Bureau's staff, who devoted much time to the collection of material for the establishment in the Bureau of Foreign and Domestic Commerce of a new division for far-eastern affairs. On his trip through the United States Julian Arnold addressed a large number of trade organizations, illustrating his talks with lantern slides. Everywhere the attaché was in close communication with manufacturers and exporters interested in China. As a definite result of his efforts, clubs for the furtherance of trade development in China were started in Seattle, San Francisco, and Chicago. This

attaché has done much to improve commercial relations between China and the United States.

At Melbourne Commercial Attaché Philip B. Kennedy put in an important year. Previous to America's entrance into the war there was in Australia much unfavorable opinion concerning our nonparticipation in the great struggle. The attaché made addresses before Chambers of Commerce and similar bodies, presenting the viewpoints and aims of the United States. Although war conditions have interfered with several trade matters which he had hoped to perfect, his success in introducing Australian purchasers to American sources of supply and in mediating in commercial disputes has been real.

#### **District Office Service.**

District offices of the Bureau have been maintained during the entire fiscal year at New York, Boston, Chicago, St. Louis, New Orleans, San Francisco, and Seattle. The office at Atlanta was closed during the year.

Cooperative offices are now maintained by the chambers of commerce in Philadelphia, Cincinnati, Cleveland, Portland, Oreg., Los Angeles, by the Greater Dayton Association, by the Cincinnati, New Orleans & Texas Pacific Railway Co. at Cincinnati, and by the Southern Railway Co. at Chattanooga. During the year offices at Dayton and Portland were established, and the office at Detroit was discontinued. The cooperative offices work along the same line as the district offices but their activities are confined to the city in which they are located and immediate vicinity. They receive substantially the same material from the Bureau as the district offices and are expected to do the same work in looking after foreign buyers and arranging for visits by Bureau officials and consuls and in giving advice and information to all manufacturers seeking markets abroad. The cooperative offices are established with the understanding that one man will devote all his time to foreign-trade work and that the office will be open to any American concern in the particular communities. The salary of this man is paid by the local organization, but he must have training and experience that are satisfactory to the Bureau.

The work of the district offices could be profitably extended in many directions if more funds were available. In most of the offices the force consists of the commercial agent in charge, a clerk, and stenographer. Two offices have two clerks and only one office, New York, has more than two. In no office is there

a trained man who has time to travel to the other cities in his district as frequently as would be desirable in order to interview interested manufacturers, address trade organizations, and promote public interests in the development of foreign trade. For some districts there should be an agent constantly traveling through the manufacturing centers, pointing out the advantages of foreign-trade developments, addressing commercial organizations, and making the public acquainted with the facilities offered by the Bureau. The work of this kind already done has proved well worth while and has been thoroughly appreciated. Additional funds will be needed in order to do much of this work.

Most of the district offices took an increasingly active part during the year in educational work. In some cities the commercial agents are connected with foreign-trade courses given by established institutions of education. Lectures are given to the students, who are encouraged to become familiar with the practical questions that arise in connection with the work of the office. In other places the commercial agents are taking a leading part in the formation of study clubs that have been formed by business men and their clerks for the purpose of obtaining a better knowledge of the conditions affecting foreign trade. Most of this work is done in the evening, and it is gratifying to note that the agents have assumed this extra burden enthusiastically in order to promote the development of foreign trade.

Near the close of the fiscal year an arrangement was made whereby the district offices were to assist in licensing such commodities as are placed on the controlled list by presidential proclamation. The offices were prepared to receive applications for licenses from the exporters and manufacturers in their districts.

During the year the sample room located in the New York Customhouse has been equipped with tables and display frames sufficient to allow the exhibition at one time of several hundred samples. The collections of hardware imported in connection with a series of reports on foreign hardware markets issued by the Bureau have been on display since late in the fall of 1916 and have constituted the major part of the exhibits in this room. There were also received during the year and placed on display extensive collections of cotton goods from British India, China, Java, Straits Settlements, Cuba, and the Danish West Indies; electrical goods from New Zealand; wearing apparel

from China, Java, the Philippines, Chosen, Japan, Siberia, the Straits Settlements, and the Federated Malay States; boots and shoes from Australia; and paper and stationery goods from South America. All of these collections consisted of samples sent in by the Bureau's special agents in connection with their reports on foreign markets for American goods. Toward the end of the fiscal year, however, plans were made for extending the work of this division by including samples of goods which are of practical interest to American manufacturers but which have not been covered by current investigations. To this end the Bureau's representatives in South America were authorized to spend about \$5,000 on the purchase of samples ranging from cotton goods to jewelry. Special exhibits were made at the following conventions during the year; New York Electrical Exposition, October, 1916; Pittsburgh Foreign Trade Council, January, 1917; meeting of Chamber of Commerce of the United States, Washington, D. C., February, 1917; New York State Retail Hardware Association, and Pennsylvania and Atlantic Seaboard Hardware Association, New York, February, 1917; Eastern States Industrial Exposition and Export Conference, Springfield, Mass., June, 1917.

There have been more changes than usual during the past year in the personnel of the commercial agents in charge of district offices. This has been due largely to resignations in order to accept better paid positions. It is always a source of regret to lose the services of an efficient and well-trained employee, but it is a tribute to the Bureau to know that our men are in demand and that they leave us to render another good service to the business community.

#### **Traveling Agent Service.**

A special division of the Bureau was created in 1917 to take charge of the field investigations by special agents—the division of commercial agents. Increased appropriations made provision for new investigations, thus making it desirable for an increase in the staff to give more concentrated attention to the work than was previously possible.

On July 1, 1916, there were 13 investigators. On January 1, 1917, this number had been increased to 18, and on June 30, 1917, there were 26 investigators attached to the new division. The creation of this division was in line with a recommendation to this effect made by the special committee of the Chamber of Commerce

of the United States, which was chosen to consider all phases of the Bureau's activities. The Latin American division, which has been rendering effective work in handling these investigations, was organized primarily to develop research and inquiry into its particular field. Its dual interest, coupled with inadequate help, was the cause of the transfer of part of its functions to the division of commercial agents. As the work demanded, readjustment in the regular staff was made to take care of this administrative work.

The functions of the division may be described as follows: To work with the appointments committee in selecting new investigators, to assist in securing the names of suitable available applicants for the various examinations, in determining the scope of the investigations and the length of time they should take, in directing the men chosen, in examining critically all their reports and correspondence, and in distributing the valuable first-hand information.

#### **Investigations Conducted During the Fiscal Year 1917.**

Owing to the interest shown in foreign markets for agricultural machinery and implements as expressed through the National Implement & Vehicle Association, the Bureau started two investigations during the fiscal year 1915 dealing with this industry. The territories selected were South Africa and Australia and South America. Commercial Agent Juan Homs was assigned to the investigation in South Africa and Australia, and he finished his field work in April, 1917, when he reported to headquarters in New York, where arrangements were made for a tour of the principal manufacturing centers in the United States.

The South American investigation, conducted by Special Agent Frank H. von Motz, was also completed satisfactorily during the year. His three monographs have already been published under the titles, "Markets for Agricultural Implements and Machinery in Argentina," "Markets for Agricultural Implements and Machinery in Brazil," and "Markets for Agricultural Implements and Machinery in Chile and Peru."

The important work on dyestuffs by Dr. Thomas H. Norton was continued into the year, and for three months he was located at New York. During the late summer and fall months of 1916 his work was largely occupied in the completion and details of publication of his monograph entitled "Artificial Dyestuffs Used in the United States." This report has had an undoubted influence in building up the new American coal-tar color industry.

Grosvenor M. Jones was selected to make a special study of the Latin American markets for coal, and in addition to make a study of fundamental problems underlying packing and general freight handling.

Ralph M. Odell continued his investigations of foreign markets for textiles during the year, spending 10 months in the British Indies. The remainder of the year was devoted to conferences with members of the American Cotton Manufacturers' Association and the National Cotton Manufacturers' Association, and private individuals interested in his work. Five of Mr. Odell's monographs were published during the year, covering the markets for cotton goods in the Dutch East Indies, Ceylon, and British India. Mr. Odell has investigated cotton-goods markets for the Bureau in practically every country in the world, and the reports that have resulted from these investigations are considered the most exhaustive and at the same time the most authoritative that have ever been published.

An investigation of unusual interest is that of the present and potential markets of South America for construction materials and machinery, which was undertaken during the year by Special Agent W. W. Ewing. His itinerary during the fiscal year 1917 covered Cuba, Panama, Venezuela, and Colombia. Monographs have already been published on the markets in Cuba and Venezuela.

The two investigations of foreign markets for electrical equipment machinery and supplies decided upon during the fiscal year 1916 were carried forward during 1917. Special Agent P. S. Smith, whose investigation will cover the South American markets, started work in the field during the fiscal year 1916, while Special Agent Lundquist, who is making an investigation in the Far East, started work in August, 1916. Mr. Smith's monographs on electrical goods in Cuba and Porto Rico have been published.

Our nearness to South America led to an investigation of the markets in that region for American fruit. This investigation was undertaken during the fiscal year 1916 and completed in 1917 by Special Agent Walter Fischer. A report entitled "South American Markets for Fresh Fruits" has been published, and Mr. Fischer has also prepared a brief report dealing with the dried-fruit situation in South America.

As a result of former Agent Roger E. Simmons's trip through South America in connection with the lumber markets and after consultation with leading trade associations in the furniture trade,

the Bureau discovered that there was much interest on the part of American manufacturers in the possibilities of South America as a furniture market. Accordingly, Harold E. Everley was selected for this work and reported for duty in March, 1917.

The Bureau reports on the hardware markets for various countries, prepared by the commercial attachés, met with so hearty a reception that it was decided to continue this work and appoint a field investigator to make a first-hand study of markets that are comparatively unknown at the present time, namely, South Africa, India, and the Near East. For this investigation Charles S. Williams was chosen.

An investigation of the South American markets for jewelry and silverware was determined upon during the year and Samuel W. Rosenthal was selected for the work. The National Jewelers' Board of Trade has cooperated heartily in arranging for this investigation.

The potentialities of the far eastern markets for American automobiles were considered bright enough to warrant an investigation of that territory, and Tom O. Jones was selected for the work. His investigation will include a study of pleasure cars, industrial vehicles, and accessories, and he will consider the possibilities of gasoline, steam, and electric vehicles in Japan, China, the Dutch East Indies, and possibly later South Africa and Russia.

According to plans made during the fiscal year 1916, an investigation of the South American markets for paper, paper products, and printing machinery has been undertaken by Robert S. Barrett. His report on Cuba and Panama has been published.

The certainty that there will be a notable development of the railways of Australia, New Zealand, China, Japan, and India within a few years after the close of the war has lead the Bureau to undertake an investigation of this important field, concerning which our present information is meager and scattered. Frank Rhea was chosen to make the investigation, which will cover the markets for railway equipment, railway material, and railway supplies.

Two investigations of the shoe and leather markets abroad were carried on during the year. Special Agent Herman G. Brock, who began his investigation of the South American markets for these lines in 1916, had, by the end of 1917, covered Cuba, Porto Rico, Jamaica, the Virgin Islands, Panama, and the West Coast

countries and planned to cover Argentina, Uruguay, and Brazil before January, 1918. His reports on the markets of Cuba and Porto Rico have been printed. Trade Commissioner Clarence E. Bosworth was assigned to the far eastern end of the investigation. Commissioner Bosworth has paid especial attention to new sources of supplies for leather products, hides, and skins.

As the most important trade associations in the textile industry have expressed great interest in the Latin American markets, an investigation of this field was determined upon in 1916 and W. A. Tucker was appointed for the work. He has had reports published on results of his investigations in Cuba and Porto Rico and Jamaica.

The markets for wearing apparel, both in South America and in the Far East, have also come in for extended study. In South America an investigation has been carried on by the commercial attachés, supervised by Special Agents Brock and Tucker, a plan which insures a uniformity which would not otherwise be possible and is working out satisfactorily. The investigation of the far eastern markets, undertaken in 1916, was continued during 1917 by Commercial Agent Stanhope Sams, whose report entitled "Wearing Apparel in Japan" has already been published.

A report entitled "The West Indies as an Export Field" was completed by Special Agent Garrard Harris as a result of his studies in those islands. This valuable commercial handbook was issued September 20, 1917.

The interest caused by the acquisition of the Danish West Indies prompted the Bureau to issue a monograph on that subject. The work of preparing the material was assigned to Special Agents Brock, Smith, and Tucker, who at the time were on their way to South America.

There is a great scarcity of information regarding forms and methods of organization and distribution in the export trade. The Bureau has long recognized the need of studying this important phase of foreign commerce and early in the fall of 1916 sent out a carefully prepared paper from headquarters to the district offices and commercial agents bearing on the subject. Some good information was procured but it was decided that in order to make any real coordinated investigation it would be necessary to secure the services of a specialist who would give this matter his entire attention. Accordingly, Prof. Paul T. Cherington, of the Harvard Graduate School of Business Administration, was selected.



Two important investigations were started during the year into the subject of investment opportunities. One of these investigations is conducted by Special Agent Halsey and is devoted to South and Central America and the other, dealing with the Far East and Russia, is in the hands of Trade Commissioner Ferrin. Their reports should cover the underlying conditions bearing on the subject of investments; Government, State, and municipal securities and finance; railway companies; public utilities; industrial companies; land, mining, oil, agricultural and timber resources, plantations, etc.; banking and insurance.

A very technical foreign investigation was initiated by the Bureau during the present year when J. Morgan Clements was appointed to make a study of the mineral resources of the Far East. The tentative scope of this investigation includes a reconnaissance of the mineral districts; a study of the mining laws and conditions which make for or against secure investment and other fundamental factors which determine the investment of capital in mining enterprises; the study of trade conditions, transportation facilities, etc., which determine why raw materials, in this case ores, go from the Far East to Europe or Japan, rather than to the United States; and a study of the mines and smelters as a market for the introduction of American mining machinery and other supplies.

The Bureau began during the year two investigations on ports and transportation facilities, one dealing with the Far East and Russia and the other with Latin America. These investigations cover ports and their equipment, railways, canal and river navigation, and also information in regard to road conditions. An investigation of oriental conditions has been undertaken by Paul P. Whitham. The Latin American study is in the hands of Grosvenor M. Jones.

The pilotage laws of the several States of this country were made the object of a special study by Mr. Jones early in the year. This involved an analysis of the statutes and regulations enforced in those States which have legislation on the subject. The report which resulted from this investigation is the most comprehensive that has ever been prepared on the subject.

A novel form of cooperation on a large scale between the Government and one of the country's large industries was inaugurated in 1917. For a number of years the lumber industry has been in an unsatisfactory condition. Prices have been unstable and the

domestic market has been demoralized. At the suggestion of prominent lumbermen the Forest Service, the Federal Trade Commission, and the Bureau of Foreign and Domestic Commerce made a study of their problems and reached the unanimous conclusion that the establishment of new foreign markets for lumber would prove of immense value in the solution of the problems at home. Accordingly these three Government agencies held a meeting in Chicago at which representatives of the leading lumber associations were present, and it was decided to make an investigation of European lumber markets, particularly with reference to conditions after the war. Four men were finally selected for the work: John R. Walker, to cover Great Britain, France, the Netherlands, and Switzerland; Nelson C. Brown, to study prospect in southern Europe and northern Africa; A. H. Oxholm, for the Scandinavian countries and Finland; and Roger E. Simmons, to investigate Siberia and European Russia. They entered upon their duties in April, 1917, when they started upon a two months' tour of the principal lumber districts of the country. They are to start for their respective foreign fields early in the new fiscal year and will be abroad approximately 18 months. Upon their return they will spend another 6 months assisting American manufacturers with their export problems.

#### **Division of Statistics.**

The abnormal conditions in our foreign trade caused a large increase in the regular work of the division of statistics, both in compiling figures for regular and special tables and in the correspondence relating to statistical subjects which is handled in this division. The number of statistical inquiries from business men actually engaged in foreign trade or contemplating entering the foreign field is constantly increasing.

The unprecedented increase in the volume of both imports and exports has made it impossible for the collectors of customs to render their monthly reports as promptly after the close of the month as during normal times, and the issues of the Monthly Summary of Foreign Commerce and other regular statistical publications have for this reason been considerably delayed. Notwithstanding the improvements instituted during the last two years in the methods of compiling the returns in the custom-houses as well as in this office, it is not probable that any considerable gain of speed in issuing the monthly publications will be possible while the abnormal foreign trade continues.

The demand for prompter statistics has to some extent been met by preparing advance statements or special articles, showing in many cases more details by countries and customs districts than are usually published by the Bureau. These advance statements are distributed to interested parties, but such service must necessarily be restricted, as otherwise the work of preparing the regular tables would suffer. If the law permitted collecting the cost of preparing specially compiled statements from the persons applying for them, which most persons would be glad to pay, the proceeds might be used for employing the additional clerks needed for this work and the service could be greatly extended for the benefit of the commercial public. The statistical office of the British Board of Trade furnishes specially prepared statements to applicants under this plan and collects thousands of dollars annually for the service.

A new edition of Schedule B, governing the statistical classification of articles exported from the United States, was prepared during the year and became effective on July 1, 1917. The number of classifications was extended to 693, an increase of 98 new classes. The task of subdividing general classes with large transactions denominated as "All other" under "Chemicals," "Explosives," "Machinery," and other groups was rendered difficult by the fact that while many were criticizing the large classes shown under these somewhat meaningless headings few were able to furnish any definite suggestions for breaking up these groups.

Efforts to secure from Congress an appropriation for the purpose of restoring the service of collecting and publishing statistics of the internal commerce of the United States, which was discontinued in 1912 on account of the failure of an appropriation for this work, have so far been unsuccessful. The value of regularly recording and publishing information of domestic commerce movements on rivers, canals, and the Great Lakes, of coastwise commerce of the Atlantic and Gulf ports, and receipts and shipments of staple commodities at the principal distributing centers throughout the country is unquestioned, in the present emergency as well as in normal times. There is at present no private or official publication showing the movements of internal or domestic commerce collectively.

#### **Latin American Division.**

The Latin American division devoted most of its time during the fiscal year 1917 to accumulating and classifying data of all kinds relating to economic conditions in Latin America and mak-

ing it available to American houses. Every effort has been made to answer inquiries by mail or telegraph very fully, and in cases where no information was available in the Bureau the inquirer was advised where to apply for it. Much time was also given to discussing with visitors their special problems in Latin American trade. Numerous appreciative letters were received concerning this service.

Some material for a directory of American houses represented in South America has been collected.

Attempts have been made, with considerable success, to interest trade organizations in working with the Bureau to advance our Latin American trade where there was opportunity to focus the efforts of such bodies and of large commercial firms with representation in Latin America on trade development plans. As an example, there is at present a great need for good roads throughout Latin America and much interest on the part of the inhabitants of certain countries in providing them. There is, however, a lack of knowledge as to the comparative expense and durability of the various kinds of paving, such as are used in the United States, for country roads and a scarcity of raw materials and of the latest road-making machinery. The need was emphasized for concerted effort on the part of American manufacturers of this machinery, paving-material producers, motor-car and motor-truck manufacturers, etc., to adopt a plan of demonstrating road building in various countries of Latin America which would benefit all concerned.

Other matters in which the division has interested itself include the printing of pamphlets containing directories of United States firms in each of a number of industries and the distribution of these throughout Latin America; action to make available to the United States the stocks of cattle in the Caribbean countries heretofore kept out of this country largely because of the cattle tick, which could be removed effectively by careful dipping; cooperation with the office of Markets and Rural Organization in the Department of Agriculture in carrying on foreign investigation work; and assisting foreign students to attend universities in the United States and obtain practical shop experience after graduation. At the close of the fiscal year arrangements were made with a well-known authority on Latin American subjects to compile an elaborate handbook for commercial travelers to South America, which will become available some time during the coming year. The large number of inquiries received

from farmers regarding agricultural conditions in South America and the prospects for homesteaders made it advisable to get out a monograph on the subject, and much material was gathered during the year with this end in view.

In view of the existing and prospective international situation, the following six lines of activity have been chosen for the immediate future:

1. Continuing and expanding the present work of collecting and classifying information on all commercial subjects; conferring with visitors, engaging in research work, and answering fully all Latin American inquiries.
2. Cooperating in every way possible with the War Trade Board and otherwise assisting in the prosecution of the war.
3. Establishing and carrying out a definite program both in Latin America and the United States to bring about a closer acquaintanceship between the two sections.
4. Compiling a number of special publications for reference and other purposes.
5. Making preparations for meeting the competition that will come after the close of the war.
6. Assisting in building up our trade with Mexico.

#### **Editorial Division.**

No less than 52 special publications were issued during the year, an increase of 19 over the fiscal year 1916. The increased output may be ascribed to the number of special agents in the field and to the new policy of publishing the reports of such agents as rapidly as they are received, instead of waiting until sufficient accumulate to make a large volume. Fewer reports than usual were received from the American consuls, who were obliged to devote most of their time to special duties. Many consuls were withdrawn when the United States entered the war.

The editorial division is responsible in a measure for all the material included in the publications of the Bureau and is wholly responsible for the form in which it is published, yet the increased output of the year was handled by a somewhat reduced editorial staff. This was possible partly because of the constantly improving quality of reports submitted by the special agents and partly because of improvements in the methods of handling the work in the division itself. Nevertheless, there were times during the year when the strain upon the staff was greater than is advisable if the traditional quality of the Bureau's publications is to be maintained.

## BUREAU OF STANDARDS.

(Dr. S. W. STRATTON, *Director.*)

Attention is especially called to the report of the Bureau of Standards for the fiscal year ended June 30, 1917. It is exceptionally full and complete, is carefully indexed, and gives information both as to the principles and practice of the work of the Service that is most valuable. It is a book which should be in the hands of every scientific man, of every engineer, and which should be available to every industry.

### **Buildings.**

The Bureau of Standards urgently needs an adequate building for the investigations into structural materials. The work is of immediate and pressing nation-wide importance. It is now done in scattered places and in very inadequate temporary quarters. The buildings in Pittsburgh, in which part of the work is done, are unsafe on account of the high temperatures required and the special nature of the work itself. They are so small that proper equipment and facilities can not be installed. There is insufficient yard space for exposure tests and for handling large test specimens. Several departments of the Government require investigations and tests of important materials. A proper building is needed for this purpose, and with the utmost speed the structure can not be furnished soon enough to prevent serious embarrassment. Because of the military emergency the Bureau has been asked by the War Department to vacate the temporary quarters borrowed from it, and if a building is not provided at the Bureau of Standards itself, where some similar work is in progress and the technical force is available, it must either be done at greater expense in private laboratories or the several departments concerned must install and operate duplicate testing equipment. Experience has shown the advantage of concentrating such work at the Bureau of Standards. It was for that purpose the Bureau was established and partly equipped. It can be done more effectively and economically there. It can not, however, be done either effectively or economically under present conditions. The results of the work will be of permanent value,

available for the entire Government for all time, and equally advantageous to the general public. It is earnestly hoped that the approval of Congress may be given to the request for a new building.

A building is also urgently required to provide for installing the 100,000-pound master precision scale which was authorized in the appropriation made June 2, 1917. The building would also provide facilities for housing the three test cars of the service while undergoing repairs and while being standardized. The master scale will afford facilities both to the Government and to the railroad companies for standardizing railroad track-scale equipment and would serve also to assist the States in standardizing any similar equipment which they may own.

The building and scale would also furnish a correct and efficient means of testing the scales and weights used in standardizing large guns and their projectiles for the War and Navy Departments.

Occupation of the new chemical laboratory began in June, 1917, and as this report is written the building is in full service. The place formerly occupied by the chemistry force in four other buildings has been wholly absorbed by the demands upon our scientific force arising from the war. Pending complete occupation of the chemical laboratory for its own special uses, a portion of it was occupied for the development of the liberty airplane motor.

Several special temporary structures have been erected for testing the airplane motors, standardizing materials and instruments for airplanes, and providing for wind-tunnel research on aircraft elements. The addition of these emergency structures enables the Bureau to cover a wide range of scientific work on military problems and to meet urgent demands for testing and research in connection with materials, supplies, and appliances required for the military services of the country.

Because of the great increase in the cost of building materials and of construction generally, the appropriation of \$50,000 for the radio laboratory proved inadequate. It was increased by a subsequent appropriation to a total of \$90,000. The plans for the building have been completed and construction is well under way. This building will permit the Bureau not only to carry on its own research and testing work on radio-communication problems but to provide facilities for use by the cooperating laboratories of other executive departments concerned with radio work.

Since the close of the fiscal year a special building of factory type has been begun for the purpose of conducting researches into metallurgical problems whose solution is urgently required for war purposes. In the same structure also it is proposed to study and standardize appliances of many kinds for military needs. The structure is rapidly progressing and is expected to be in use by or about the close of the calendar year 1917. The sum of \$100,000 has been allotted from the fund for national security and defense to provide for the necessary equipment.

#### **Household Circulars.**

It will be recalled that on August 28, 1915, the Bureau of Standards published one of its so-called "circulars" entitled "Measurements for the Household." It met with immediate and widespread approval and has been of great use as an encyclopedia for the home on the subject of measurements and as a book of reference and instruction. The second volume of the series is now in the press, entitled "Materials for the Household." It is believed that the demands for this publication will be even larger than those for its predecessor. It will be sold through the Superintendent of Documents of the Government Printing Office at a nominal figure. The third volume of the series, entitled "Safety for the Household," is practically ready for the printer.

#### **Special Appropriations.**

The appropriation bill approved June 15, 1917, provided the funds described below for the purposes stated.

Two hundred and fifty thousand dollars to enable the Bureau of Standards to cooperate with the War and Navy Departments by providing the scientific assistance necessary in the development of instruments, devices, and materials, and in the standardization and testing of supplies, including personal services and rental of quarters in the District of Columbia and elsewhere; the erection of temporary structures; books of reference and periodicals; and all other necessary items not included in the foregoing.

One hundred and fifty thousand dollars to provide, by cooperation of the Bureau of Standards, the War Department, the Navy Department, and the Council of National Defense, for the standardization and testing of the standard gauges, screw threads, and standards required in manufacturing throughout the United States, and to calibrate and test such standard gauges, screw threads, and standards, including necessary equipment, rental in Washington



and elsewhere, erection of temporary structures, office expenses, books of reference and periodicals, personal services in the District of Columbia and in the field, and all other necessary items not included in the foregoing.

Under the authority thus given, the work of the service in actively cooperating on the scientific side with the various bureaus of the War Department and the Navy Department is greatly enlarged. This has required considerable addition to the working force, which on October 1, 1917, stands at a total of 716 as compared with 415 a year ago. The force now employed is the largest in the history of the Bureau of Standards.

The relations thus actively existing between the military services and the Bureau of Standards are intimate, harmonious, and cordial. By far the largest part of our staff is engaged upon work which either directly or indirectly is of military importance. As the buildings now under construction are completed, this work is expected to increase in volume and value.

#### **Utilization of Waste Paper.**

The Director of the Bureau of Standards points out that the utilization of waste paper for remanufacture into paper is growing in importance each year. At the present time over 25 per cent of all paper made is collected for remanufacture and a very large part of it is used in making white paper. Under existing methods, however, a large percentage of the material is lost in the recovery process. A study of present recovery methods is progressing in the hope of developing more economical ones. An interesting incident of this work during the year was the use of some of the waste-paper material taken from the wastebaskets in the offices in the Commerce Building for the manufacture of such paper as is used for multigraphing and general office pad purposes. It was found that less than half of the material taken from the Department's scrap baskets was sufficient to produce an amount of paper adequate to supply the needs for the purposes named. The demands upon the experimental paper machine for its regular laboratory work have made it impossible to pursue the manufacture of paper from our waste material for the present, but it is hoped that by the addition of further needed equipment the matter may be taken up in the future.

#### **Standardizing Manufacturing Gauges.**

The subject of standards and the development of actual standardization have become a strict necessity in almost every branch

of science and industry. Its benefits should eventually be extended to include all branches. Fundamental kinds of measurements and properties of materials naturally develop first. For example, the standards of length and the standardized system of gauges and measuring tools used in mechanical shops is at present the vital problem in munitions factories. The rapid production of the modern Army rifle is impossible without such equipment. The Bureau of Standards has installed the elaborate equipment and the trained personnel requisite for standardizing such gauges, and is now cooperating with many branches of the military and naval establishments in standardizing their master gauges and precise measuring instruments. This work is one which requires the most intimate and thoroughgoing knowledge of the best shop practice. It affects the production of machines, motor trucks, airplane motors, and munitions of every sort. If shops are to work to an accuracy of one ten-thousandth of an inch, the Bureau must be prepared to standardize the measuring instruments to a much higher order of accuracy. This involves direct reference to the fundamental standards of length and the most precise methods known for checking such apparatus. It need hardly be added that a work so important for purely military purposes will be of equal importance in every branch of industry.

The special appropriation granted at the last session of Congress has made it possible for the Bureau of Standards to provide an accurate and efficient gauge standardization service for the arsenals, gun factories, and munitions manufacturing plants. The Bureau was prepared, as soon as the need arose, to furnish accurate standardization of the weighing equipment used in connection with the manufacture of shells. The weight of powder charge and shell is an important factor, since it determines the accuracy with which projectiles follow their computed trajectory.

#### **Standardization of Apparatus for Determining Weight, Area, and Volume.**

The standardization of area-measuring instruments is in some respects more highly technical than that of length measurements, since it involves to a greater degree the principles of higher analysis. The work comprises the standardizing of area-measuring instruments, such as specialized forms of area-measuring planimeters for determining areas on maps and drawings. An important application of the Bureau's work is found in its recent investigation of leather-measuring machines which determine

the area of hides from which the selling price of expensive hides and skins is determined. The importance of such standardization is shown by one machine in which the error in price computation was found to be nearly \$90,000 a year. This brief investigation showed that the methods used in the design and test of these instruments had been hopelessly inadequate.

An example of the aids which exact measurement provides for the convenience of sealers and industrial inspectors is found in the fact determined by the Bureau that with certain simple corrections a capacity standard, such as a 3-gallon measure, can serve in place of the more elaborate and cumbersome test weights now used in testing large-capacity commercial weighing scales. Three gallons of water at ordinary temperature, for example, weigh 25 pounds within the range of accuracy demanded in the most accurate commercial work.

During the year just past the track-scale testing work conducted for the past three years by the Bureau of Standards has been extended to calibration of railroad master scales. These are scales whose accuracy is the basis of standardization of all scales in a large territory, usually a State. Fifteen such master scales were tested; only three were found within the tolerance, and five more were so defective in construction or in such bad repair as to be impracticable of accurate adjustment. It is to be noted that the standardization of such master scales is almost the only means by which the accurate weighing of upwards of two billion dollars' worth of freight annually is effected for the shippers and consumers. Scales of this type were tested for the Federal Government, State Governments, railroads, and other large industries.

The Bureau assists in the size standardization of commercial containers as illustrated by its administration of the lime-barrel act, which provides two mandatory standard barrels for use in interstate commerce, containing, respectively, 280 pounds and 180 pounds net, and requires that barrels of less capacity be stamped with the net weight of the contents. The Bureau prepared rules and regulations for enforcing the act. These involve the technical study of formulas for computing the contents of the type of barrel established by law. A new formula was developed by the Bureau for this type of barrel. Charts and other data were compiled for convenient use by manufacturers of barrels and the Bureau cooperated with them in producing barrels of standard size.

A good example of the standardization of volume-measuring apparatus having a nation-wide interest and distinct commercial importance is shown in the Bureau's recently completed investigation of liquid-measuring pumps used for retail delivery of specified volumes of almost all kinds of lubricating and fuel oils. The majority of the pumps tested were found unsatisfactory in construction and accuracy, notably in the direction of short measure. The Bureau has cooperated with the manufacturers of such instruments and with the local inspectors as to the best methods of improving the design and correcting such errors, in the interest of users of gasoline and other oils. Standards of construction have been formulated by the Bureau for the guidance of maker, user, and inspector, with all of whom the Bureau has been working in close cooperation throughout all phases of this investigation.

The Bureau has adopted a standard screen scale for the standardization of sieves for industrial uses. Such sieves and screens are essential in many important industries. The degree of fineness in numerous industrial products, such as cement, emery, sand, medicinal powders, and the like, is an important factor in their reliability and efficiency. The divergence found in the grading of sizes for want of a standard screen scale will be eliminated by the general adoption of the Bureau's conclusion. This work should eventually cover the entire range from the coarsest screens used in mines and quarries to the finest bolting cloth and fine sieves used for cement and other materials having, in some cases, as many as 120,000 openings per square inch.

The Bureau's efforts to secure throughout the country substantial uniformity of law and practice regulating the local inspection of weights and measures are rapidly bearing fruit. To further facilitate such practice, the Bureau has issued the tolerances recommended by the annual conference on weights and measures and has prepared a compact manual or handbook designed for field use of inspectors. At the invitation of the State governments, the Bureau's representatives addressed the meetings of State weights and measures officials in Indiana, Massachusetts, Michigan, New Jersey, Pennsylvania, and West Virginia, on the technical aspects of the inspection service.

A fund of approximately \$25,000 is required to provide for co-operation with State and local officials in the administration of national laws concerning containers, weighing devices, and similar matter.

**Technical Conferences.**

The Bureau has had almost daily during the year technical conferences on a widely varying list of subjects within the fields of the Bureau's work. These conferences are the means by which the Bureau reaches the technical organizations and specialists who are concerned with the application of the results of the Bureau's work. Incidentally, the Bureau gains a closer contact with the pressing problems in the industries and in the engineering of public utilities. The conferences are, therefore, a mutually helpful means of interchanging experiences and information. For example, conferences were held on the subject of the mitigation of the serious effects of electrolysis on underground structures in cities; on the technical program for the fire tests of various types of building walls and partitions, a part of the Bureau's general investigation of building materials; on the methods of investigating and testing fire-resisting materials for ship construction; on the technical problems connected with scientific work on nonferrous alloys; on international aircraft standards; on the design and manufacture of aeronautical instruments for military use; shell specifications; electrical welding; and many similar subjects.

The Bureau has also cooperated with the technical societies of the country, with industrial organizations, and public-utility commissions on problems of special interest to these three groups. The conferences at which the Bureau was officially represented were held to discuss such topics as the following: Copper plating, production of plastic lime, national electric safety code, national gas safety code, insulating materials, technology of clay products, quality of oilcloths, analyzed chemical reagents, State inspection of weights and measures, standard-barrel law, refrigeration constants, metric system, uniform boiler laws, photomicrographic standards, gasoline standardization, by-products coke ovens, analysis of fats and oils, bulkheads for ocean-going and lake vessels.

A very gratifying aspect of the Bureau's work along these lines is the uniformly hearty cooperation which has been accorded to the Bureau by the scientific and technical specialists of the country and by the larger technical societies and industrial organizations.

**Measurement of Time.**

Many industrial measuring processes involve the measuring of minute intervals of time. The Bureau has developed the application of the tuning fork, which permits of convenient time meas-

urement to 0.01 second. The simplicity and reliability of this method has caused a number of industrial laboratories to install a similar equipment.

### **Use of Waves of Light as Standards.**

The use of the wave lengths of light as standards in laboratory work and in astronomy has made it necessary that certain wave lengths be determined with the highest precision. During the past year the Bureau has greatly extended this work by including more than 100 of the radiations selected as standards. The unit used in this work is one-millionth of a millimeter, and the measurements have been made with an accuracy of one part in four or five millions. This work is of fundamental importance in the highly developed technical work of astronomical and chemical laboratories. In chemical work the particular application of spectroscopic methods lies in the analysis of minute quantities of compounds. Frequently, also, the spectroscopic analysis can be made more quickly and easily than a chemical analysis and can detect the presence of materials for which chemical methods are inadequate or which in some cases could not possibly be analyzed by chemical means.

In the precise optical work demanded in the modern laboratory the use of vacuum tubes containing traces of rare gases has been found extremely useful as light sources for certain radiations. The rare gases of the atmosphere have been isolated and vacuum tubes of quartz and pyrex glass have been made with the standard pressure most suited to spectroscopic work.

### **Standardization for Refrigeration Engineers.**

The determination of the numerical constants needed by refrigeration engineers in the design and operation of refrigerating machinery and plants resulted in the development of a novel type of calorimeter, for making precise heat measurements, called the unstirred or aneroid calorimeter. Using this calorimeter and other precision apparatus, the work completed has included the determination of the specific and latent heats of liquid ammonia, which are of the utmost importance in the theoretical and practical design of refrigerating apparatus. This work was undertaken at the request of the American Society of Refrigerating Engineers and the American Association of Refrigeration and with the full cooperation of both of these societies. The program now approaching completion aims to include all factors which affect the refrigerating efficiency of the materials used.

### **Standard Temperature Measurements.**

A fundamental work now in progress is the comparison of the resistance thermometer scale of temperature with the standard international hydrogen scale, with a view to utilizing the high instrumental sensitiveness, reproducibility, and convenience of the platinum resistance thermometer as a basis for temperature measurements. With proper care in the use of the resistance thermometer this work will mark important progress in fundamental temperature measurements.

The issue of standard samples for determining the fixed points on the high-temperature scale is now a fact, and the Bureau has available for distribution samples of tin, zinc, aluminum, and copper, each of exceptional purity, and therefore having a definite melting point, which has been determined and certified by the Bureau.

The Bureau's experience of more than 12 years in standardizing clinical thermometers has lead it to adopt a new and more rapid method of certification. The quality and accuracy of such instruments has greatly improved since the Bureau's work began. The proportion of thermometers now rejected on account of errors has fallen to below 6 per cent. The principle involved in the new method is to certify that the variations of the instruments fall within an established permissible range. This range has been carefully fixed to fully meet the needs of the medical profession as regards accuracy.

### **Color Standards for the Industries.**

The measurement and specifying of color have recently been found to have important uses in the industries. The Bureau has investigated and developed methods for describing colors in terms of units of measure, has designed the necessary apparatus and secondary standards for use in color comparisons, and furnished information and advice regarding the subject to the technical experts in the industries concerned. Important applications have been recently suggested in connection with certain military problems. The fundamental problem in connection with color standards is the precise definition of white light, a highly technical problem. Much work has been done on this subject. Examples of the use of working standards of color are given in the Bureau's work on color matching of tungsten lamps with acetylene flame standards, where the color matching is done by adjusting the voltage; the testing of the "artificial-daylight" glasses, made necessary by the recent work of illuminating engineers in develop-

ing commercially the quality of light known as "artificial daylight." In this connection, the Bureau has developed and demonstrated experimentally an original method for producing artificial daylight.

Another example is in the industrial use of colored salts and other substances in solutions and colored glasses used as working standards of color in the industries. Specimens have been systematically prepared and their optical properties recorded. Important applications are also seen in the yellow tints of butter and oleomargarine, in the specific color of lights and of glasses used for protecting the eyes, of cottonseed oil, and of paper and tracing cloth. These examples illustrate the wide use of the physics of color in placing commercial specifications on a scientific basis.

### **Optical Researches.**

A survey of American lenses has been in progress at the Bureau with a view to showing where they can be used to best advantage to replace foreign-made lenses. Lenses and cameras have been studied with a view to their use in telephotography. Excellent results were obtained in the laboratory. The standardization of types of glasses used in the optical systems used for military purposes will make possible the production of telescopes, periscopes, and other instruments in the shortest time. The Bureau has tested many optical instruments for both the Army and Navy and has consistently cooperated with the manufacturers in improving the output. An improvement of over 50 per cent in quality has been noticed within one year. An interesting application of optical methods to the study of strains in glass has been made in its relation to the production of American-made chemical glassware.

The energy of radiation, whether heat or light, has become a subject of the highest scientific importance. One section of the Bureau has been doing research on the fundamental problems in radiometry. For example, the mechanical equivalent of light computed by various methods appears to be about 49 candles = 1 watt, a determination recently made at the Bureau. An important investigation was to determine how the eye responds to lights of different colors when each comprises the same energy. A study was made of the eyesight of 130 persons and a curve showing the visibility has been deducted from the results. The smallest amount of light perceptible to the unaided eye has been



computed as a result of these researches. The study of the energy in radiation has led to the development of special glasses which are opaque to injurious radiations, especially the harmful invisible radiations which accompany the visible.

#### **Perfecting the Methods of Standardizing Tests of Sugars.**

In technical work on sugars, the saccharimeter is used to determine the percentage purity of the material. During the past year a correction was made in the basis of such work which saved \$60,000 annually in the Government revenue derived from imported sugar. The Bureau's discovery of an error in the international basis for the 100-degree sugar point will be made the basis of enhanced accuracy by the Bureau at an early date without waiting for international action, which has been delayed on account of the war. A very important work has been done by the Bureau in standardizing the Baumé scale, used industrially for indicating the density of sugar solutions. More than 20 divergent scales were found in use, resulting in great confusion and misunderstanding. The new scale developed by the Bureau is based upon the most reliable data available, is made standard at ordinary temperatures, and has a numerical basis already adopted by the Manufacturing Chemists' Association of the United States and by all American manufacturers of hydrometers.

#### **Standardization in Medical Work.**

A striking illustration of the need for standardization in connection with the practice of medicine is found in the Bureau's work on blood-counting apparatus, which is essential in modern diagnosis. This investigation, undertaken at the request of manufacturers of such apparatus, showed that in some cases the errors in existing instruments were as high as 25 to 100 per cent, errors which would be intolerable even in the permissibly cruder measures of daily trade. This work resulted in the adoption and issue of tentative tolerance specifications which meet the general approval of manufacturers and of experts in blood analysis.

#### **Testing of Radium.**

Through the courtesy of the Secretary of the Interior and the Director of the Bureau of Mines, two tubes of radium, aggregating 140 milligrams, having a market value of \$14,000, have been permanently transferred to the Bureau of Standards. These are a valuable addition to the standard equipment used by the Bureau in comparing samples of radio-active materials submitted for accurate test.

As is well known, radium products are used in the manufacture of self-luminous preparations for the dials of watches, compasses, and particularly for the dials of aeronautic instruments of every sort. Nearly \$700,000 worth of radium contained in 288 separate preparations has been tested during the past year.

### **Chemistry in Standard Testing.**

Miscellaneous materials, such as cement, lubricants, rubber, leather, and paper, require a large amount of chemical work in connection with analyses and tests. The aim is to correlate as fully as possible the results of chemical analyses with the physical properties. This work has resulted in new methods of analysis and test and the development of essential apparatus. In some cases new formulas and new materials have been developed. Forms of colloidal cellulose have been prepared with a view to its use as sizing. Also, a finely-divided form of cellulose has been used as a filler for map paper print with wet plates. The results proved excellent. Some 9,000 chemical tests were made of various materials during the year. This work is of special value in correlating the performance of materials in service with the results of the laboratory tests.

Original research has resulted in improving the methods for estimating carbon in steel which were developed at the Bureau. The method is highly accurate and also very rapid. A method for determining gaseous nitrogen in steel has been devised and proved satisfactory in actual tests. The methods for determining oxygen in steel have been improved and the results will soon be published. A careful investigation is still in progress to determine the chemical and metallographic characteristics of steel ingots.

An excellent example of scientific methods designed to avoid waste and secure satisfactory standards of quality is afforded in the platinum investigation of the Bureau. A novel method for testing platinum ware was developed which is based upon the loss of weight by evaporation of impurities at certain temperatures.

### **Standards for Electrical Practice.**

After four years of study into the life hazard in electrical practice the Bureau published in November, 1916, the National Electrical Safety Code to indicate standards of practice for the regulation of construction, installation, and operation of electric utilities from the standpoint of safety. This code is intended to be adopted by State, industrial, and public-service commissions

and municipalities, and to be complied with by public-service and industrial corporations. While in no sense mandatory in character, the code has met with widespread approval and has been adopted in some form by the administrative body concerned in each of 14 States. It is used by the inspection services of many cities and by boards of underwriters. It has been voluntarily applied by many public-utility companies and by industrial concerns in their own practice. Use is confirming the reasonableness and adequacy of the code as formulated. The code will be subject to revision as technical progress demands.

The publication entitled "Standards for Electric Service," forming Bureau of Standards Circular No. 56, has met with a gratifying reception. A number of cities and States have adopted in whole or part the recommendations therein, and others are now giving careful consideration to them.

Attention is especially directed to the study made by the Bureau of Standards of the various problems arising from electrolysis. The report of the Director contains on pages 421 to 424 a summary of the work of the service on this important theme which all interested should read.

#### **Researches on Gas Standards.**

A novel type of gas balance devised at the Bureau permits the direct and rapid determination of the specific gravity of gases. Reproductions of it are now in use by a large number of natural gas companies. The Bureau is cooperating with the makers of physical-chemical apparatus to make this valuable balance available to scientific laboratories generally.

A remarkably successful and novel instrument has been designed by the Bureau for detecting the presence of dangerous combustible gases found in mines, submarines, and in other inclosures. The device is one which could be developed only by the application of advanced technical physics.

In response to a joint request of the city of Chicago and the People's Gas Light & Coke Co. of that city, concerning the relative usefulness of gas of 565 heat units per cubic foot and of 22 candle-power, the Bureau completed and reported on an extensive investigation of the influence of variations in pressure of rate of gas, of adjustment of gas appliances, of heating value, and of composition of the gas and variation of heating value upon the efficiency of utilization. The result shows that, with reasonable precaution, the heating value is a direct measure of the usefulness of the gas. The Bureau's work upon the standardization of gas

has resulted in the development of standards for gas service which have been published in tentative form as a Bureau circular.

An investigation of 10,000 gas-mantle installations in 10 leading cities of the country has emphasized the need for the systematic inspection and care of gas-mantle lamps for street service. The subject is discussed in detail in a forthcoming technologic paper of the Bureau.

#### **Standard Electroplating Practice.**

The Bureau's investigation of the theory and practice of electroplating, with a view to standardizing such operations, is still in progress. A plating laboratory having a capacity of 3 kilowatts is being installed. The Bureau's work thus far has covered a number of fundamental scientific questions in an experimental and practical way. As a result of the work already done, there has been placed on the market a new and satisfactory molding wax. The results indicate that fundamental scientific research in this field is finding great favor with the industry.

#### **By-Product of Research on Tarnish.**

Incidental to the study of silver tarnish and the means of avoiding or removing it, the Bureau made a study of the nature of such tarnish, which was found to consist of silver sulphide. It was found possible to prepare samples of this material in the form of wire and strips, like a metal. The product was found to exhibit remarkable electrical properties, which will be described in a forthcoming publication.

#### **Measuring Temperatures in the Steel Industry.**

In the scientific control of industrial processes, the Bureau has for three years been investigating and reporting upon the best methods of temperature measurement in steel plants, such as the measurement of rolling temperatures, and the temperatures of the molten steel in the open-hearth furnace, in the Bessemer converter, and during pouring and teeming. The control of furnace casting and ingot teeming temperatures was found entirely feasible with the use of pyrometers employing monochromatic light; that is, pure light of a single wave length (color). Such pyrometers permit observation from a distance of the temperatures of streams of molten metal. In this connection the melting points of some 140 steels of different composition have been determined during the year by using the optical pyrometer.

**Making Rails Safe.**

The Bureau has cooperated with the railroads and steel mills in placing the manufacture of steel rails upon a standard basis for producing safe rails. During the past year the problem of determining the nature and causes of transverse fissures in rails has been investigated from the physical, chemical, and metallographical aspects. The solution demands the utmost resources of the scientific and technical laboratories. A study is also under way to determine the causes of car-wheel failures. The heating of the rim of the wheel by friction of the brake shoe has been found to cause cracking and failure. The stresses so produced in some cases exceeded 20,000 pounds per square inch—dangerously near to the breaking strength of cast iron.

**Magnetic Testing of Steel.**

In the design of electrical machinery, a knowledge of the magnetic properties of the steel used is of the utmost importance in obtaining efficient operation. The Bureau has made a careful study of the standards used for comparing the magnetic properties of such steels. The problem is also directly related to magnetic testing of the properties of industrial structural materials for use in tools, rails, and machines. The methods of magnetic analysis are equally applicable to the raw material and the manufactured product. The Bureau's work has established a direct and known connection between the magnetic and mechanical properties, by means of which it may shortly be possible to predict the mechanical properties from a simple determination of the magnetic properties. The peculiar advantage of this method in which it differs from any previous method is that the material is in nowise injured by the test. A successful application of this work has been made to a number of tools and other products such as drills, ball bearings, etc. It is even possible by the use of this equipment to establish the existence of initial stress in a steel rail, resulting from cold straightening of the rail required after rolling. Furthermore, by the same means, the difference between rails which have been made in summer and those made in winter is made clearly perceptible.

**Research on Iron-Carbon Alloys.**

In developing the scientific knowledge of carbon-iron alloys, the Bureau has cast suitable ingots in the new vacuum furnace and forged, rolled, or drawn them for various tests and detail studies.

This work is part of the larger program for determining the effect on steel of different elements, such as sulphur, manganese, phosphorus, under ideal and accurately known conditions.

#### **Durability of Bronze and Brass.**

The use of brass and bronze in structural work results in frequent failures, sometimes from causes not accounted for. The Bureau has investigated in a thoroughgoing manner the causes of failure, especially from the point of view of the internal stresses set up by corrosion. The microstructure indicates alteration in the relative stresses set up. Experimental tests are in progress to determine the precise effects of corrosion under simulated service conditions.

#### **Standardizing Data on Steel Columns.**

The most extensive and important investigation of steel columns ever carried on is now being conducted under the joint auspices of the Bureau of Standards, the American Society of Civil Engineers, and the American Railway Engineering Association. An accurate knowledge of the strength of columns, which has never been available to engineers, is fundamental to economical and safe design of every sort of structure, buildings, bridges, machines and tools, and the collation and publication of the results of this investigation, which comprises a total of 240 columns, will be of notable value to engineers and architects.

Until the Bureau took up the investigation of large bridge columns, no adequate testing equipment was available for large bridge members. An investigation on this subject has been completed by the Bureau and the results will be available within a few months in the form of a technologic paper.

The test of the large testing machines used to measure the strength of materials by crushing or pulling apart standard samples of such materials has come to be a matter of urgency. Some of the larger testing machines are not verified and the reliability of the results given by such machines can not be assured. During the year the Bureau tested a number of such machines up to 50,000 pounds by special apparatus developed by the Bureau. A standard test specimen has also been prepared for checking the constancy of the Bureau's most accurate testing machine.

#### **Standardization for Structural Fire Prevention Engineers.**

The Bureau is cooperating with architects, builders, and building commissions of States and cities by experimental determina-

tions of fundamental engineering data affecting the use of building materials. Many of these data refer to the structural strength of materials. As part of this general program, an important investigation also covers the determination of their fire-resistive properties. These are of fundamental importance in the design of buildings and other structures from the standpoint of maximum safety from fire hazard. The program of tests is now in progress on a series of building columns of various sections and materials, mounted within a gas-fired furnace and kept under normal working stress by a hydraulic loading device. Exact-temperature readings are taken at various points of the specimen and the strains which the column exhibits are measured. In another type of test the column, after being heated in a specified way, is exposed to a stream of water from a fire hose to simulate the actual conditions to which structural members are exposed in a conflagration.

In connection with the above tests, a detailed study is also being made of the heat conduction of column-covering materials of the common sorts. The outcome of this and related lines of work will be of great assistance in a national building code, to be based upon fundamental scientific information instead of the insufficiently coordinated, empirical information hitherto available.

#### **General Engineering Investigations.**

The range of investigations made possible by the unique equipment of the Bureau of Standards is just beginning to be realized. The investigations of structural members for high buildings, for bridges, of materials for ship hulls, for bulkheads, the experimental study of wire rope under simulated service conditions, the strength of brick piers, the study of the frictional resistance of various types of earth on which foundations must be built, are examples of interesting lines of work on which satisfactory data are lacking. These data the Bureau is endeavoring to supply through accurate experimental determinations on a full-size scale. It has been found impracticable to arrive at reliable results from the test of small samples. Another line of work, the importance of which can not be overestimated, is the regular testing of the structural supplies which enter into the large-scale engineering enterprises of the Army, Navy, and civil departments. By means of the Bureau's tests, the strength, durability, and efficiency of the Government construction work is thus assured so far as the materials are concerned.

An interesting example of the testing of structural materials is found in the test building, in which 56 panels of stucco of differ-

ent composition are being exposed to actual weathering conditions at the Bureau. During the year 22 additional panels were added, making 78 in all.

### **Special Engineering Tests.**

Another interesting illustration of the fundamental importance which often attaches to devices which at first glance appear to involve no particular technical requirements, is seen in the radiator return line valve whose function is to maintain the maximum temperature within the radiators of vacuum-heating systems. This it does by removing the air and water of condensation while preventing the escape of the useful uncondensed steam. The economy of heating systems is very closely associated with the reliability and the accurate functioning of these valves. The Bureau of Standards has tested with minute care and detail nearly all the important types. The cost of wasted steam in Government buildings alone, which might result from the use of improperly designed return valves, would amount to a very large figure in the course of a year.

The reliability of lanterns, even, may in important situations be of the utmost moment, and on this account the Bureau of Standards investigated the persistency of lantern flames under conditions of high wind. For this purpose a wind tunnel was used in which air velocities approximating 60 miles per hour were obtained. In this manner, by exposing all lanterns to the same conditions as regards air velocity, an accurate and reliable index of their performance in unfavorable weather was obtained. Investigations of this character requiring as they do but a relatively small expenditure of time and money repay their cost a thousand-fold.

### **Consolidation of Cement Investigation and Testing.**

The cooperation of the Secretary of the Interior in transferring to the Bureau of Standards of this Department the cement laboratories and cement-testing equipment at Denver and San Francisco is acknowledged. This is especially appreciated in view of the important step which it made possible, viz, the consolidation of the testing of cement for all Government departments. This action of the Secretary of the Interior, which is the final step in concentrating this work at the Bureau of Standards, has enabled the Bureau to take up the cement work heretofore conducted separately by the Reclamation Service.



This also affords the Bureau the facilities needed for testing locally the cement required by all other Government departments in the districts west of the Mississippi. Perhaps the most striking value of this concentration lies in the fact that the Government cement enterprises thus afford the Bureau the opportunity to investigate on a large scale the effect of the quality of cement upon its durability. The field of research thus opened up has already given promise of results of very great industrial value.

#### **Standardizing Aeronautical Instruments.**

The rapid development of aeronautics, particularly the airplane, has called for a range of instruments for measuring altitude, velocity acceleration, inclination, and direction. These include the ordinary aneroid barometers, barometers with altitude scales, pressure gauges, special types of Pitot tubes for indicating the speed of an airplane relative to the atmosphere, inclinometers for measuring the slant of the planes in any direction thermometers, for showing the temperature of the air and of the cooling water in the radiator, and pressure gauges for indicating the proper functioning of the gasoline and lubricating oil supplies. These instruments are vital to the safe and effective maneuvering of an airplane. They are the pilot's guide in climbing and in landing, in driving through banks of clouds, and in overtaking a distant enemy. This work at the Bureau of Standards has already resulted in technical specifications used by the military services in their purchases for the war.

#### **Safety on Shipboard.**

At the request of the Steamboat-Inspection Service, which finds it necessary to specify what types of fire extinguishers may safely be used on shipboard for first-aid purposes in incipient fires, the Bureau of Standards made an extended investigation covering the examination and testing of 75 different makes of hand fire extinguishers. It was significant that a large proportion of the hand extinguishers were unreliable and unsuited for their purpose. The vital importance of technical investigations in a field of this kind needs no argument when it is considered that the lives of many persons may depend upon the reliable performance of this small article of equipment.

#### **Researches on Paint.**

A typical example of the study of material from the point of view of standard quality is found in the paint investigations and

tests of the Bureau. Service tests of both paints and varnishes were made for the General Supply Committee, a color scale for varnishes was devised, and an information circular was prepared on paint and varnish, describing raw materials, methods of manufacture, and methods of applying both materials. The formula was developed for a paint of extreme whiteness which would dry flat and have suitable adhering qualities.

#### **Standard Research on Spark Plugs.**

An example of the extreme complexity, which sometimes develops in the investigation of what, to the layman, are apparently simple problems, is seen in the investigation now being carried on at the Bureau, of the behavior of spark plugs. The proper action of a spark plug is vital to internal-combustion engines. In the military airplane the life and safety of the aviator depend in a most direct manner upon the spark plug. In this investigation, experts of five classes were required—a gas-engine expert who should know the application and effect of ignition devices on the operation of the engine, an electrical expert to define the electrical resistance properties of the spark plugs as they affect the proper conduction and insulation of the igniting current, a heat-transmission expert to make the measurements of the temperatures to which the plug is exposed and the manner in which that temperature varies from point to point through the body of the plug, an expert on thermal expansion to determine the stresses set up in the spark plug by the temperature gradients (these are the stresses which cause plugs to crack in severe service), and the expert ceramist to guide in the selection and preparation of the porcelains which form the insulating and heat-resisting body of the majority of the plugs.

#### **Rubber and Leather Researches.**

The Bureau's work on leather and rubber is of a particular interest. The effect of different tannages on the relative wearing qualities, and the possibility of using fishskins, including the methods of tanning such skins, are being carefully examined. The work of the experimental rubber manufactory has been continued, and data secured on the effect of heat on rubber goods. Sole leather and rubber compounds used in making shoe soles have been studied by the special machine designed at the Bureau for this purpose. Eighteen compounds were examined. It was found that the apparatus was well adapted to testing tire stock

also. A study is being made of the chemical properties of solid rubber automobile tires with a view to using definite specifications and tests for defining such equipment.

### **Textile Investigations.**

The textile work of the Bureau exhibits a range of very practical, researches in progress, such as comparison of cotton and wool flags the identification of textile fibers, a study of sewing-machine stitches, and the strength of various weaves.

In studying the fabrics used for balloon construction the Bureau has developed a method for studying the amount of leakage through balloon fabrics. A specification for the characteristics of such fabrics has been developed, including gas permeability, weight, and strength, and the definition of the necessary tests to determine all of these factors.

### **Research on Portland Cement.**

An example of the value of technical research is found in the definite determination by the Bureau that the compressive strength of cement depends upon the fineness of grinding. The results of the Bureau's work show that for each per cent increase in fineness there is an increase of 2 per cent in strength. Other investigations include the study of the effect of magnesium in cement, a study of the relative amount of grains of different fineness, the preparation of standard fineness samples, the study of effect of sea water and alkali water on concrete, and especially the study of water-proofing and methods of hardness acceleration.

An excellent example of standard of quality is afforded in the standard cement specifications adopted by the Government and now enforced in all departments of the Government through the tests at the Bureau of Standards. This has just been approved by the great national engineering societies and is, therefore, the standard for the entire country. This achievement is unique and will establish a uniformity in this industry which is found in practically no other.

### **Clay, Stone, and Glass Investigations.**

The researches on clay products are of great importance to the structural industries. These include a study of the physical characteristics of terra cotta, a report on the strength tests of hollow building tile and of walls constructed of hollow building tile, a study of the characteristics of silica fire brick as used in by-product coke ovens and in the steel industries, a study of general

clay refractories, a study of the clays used in making glass pots and graphite crucibles and, finally, the study of the entire field of hard fire porcelains in which the various properties, such as softening temperature, vitrification range, and volume changes, are being determined for 90 different porcelain compositions.

The Bureau is studying the building stones of the United States, in cooperation with other bureaus concerned. The investigation is of the highest importance to architects, structural and designing engineers, and to the stone-quarrying and manufacturing industries. A collection of samples is now being made by the Bureau and tests of their quality are under way.

The work in developing the manufacture of optical glass has progressed speedily during the fiscal year. In the latter half of that year a furnace was installed having a pot containing a charge of 1,000 pounds. With this it was found possible to make successful melts of crown and prism glass. In view of the urgent demands for the material a new kiln house with eight melting furnaces and suitable molding equipment has been completed since the close of the fiscal year and is in operation in the premises occupied by the Bureau of Standards at Pittsburgh.

Experiments are being conducted upon other glasses which are in demand. Pots for use in the manufacture of optical glass are now being made from domestic raw materials.

The production of optical glass for military purposes was taken up as a military exigency, since the foreign supply of this glass has been cut off by the war.

## **BUREAU OF THE CENSUS.**

(SAM. L. ROGERS, *Director.*)

### **ORGANIZATION AND SCOPE OF WORK.**

Since my last report the organization of the Census Bureau has been changed by the creation of a new division, the division of cotton and tobacco statistics (provided for by the act of May 10, 1916); by the reestablishment of the division of agriculture, which went temporarily out of existence at the close of the Thirteenth Census period; and by the appointment of an additional chief statistician (authorized by the legislative, executive, and judicial appropriation act approved Mar. 3, 1917) to have general authority and supervision over the work of these two divisions.

The diagram on the opposite page shows graphically the present organization of the Bureau. The work of the several divisions may be briefly stated as follows:

#### **Administrative Division.**

General supervision of personnel, including appointments, promotions, transfers, etc.; handling of general correspondence; distribution of publications; preparation of press summaries; other work not belonging especially to any other single division.

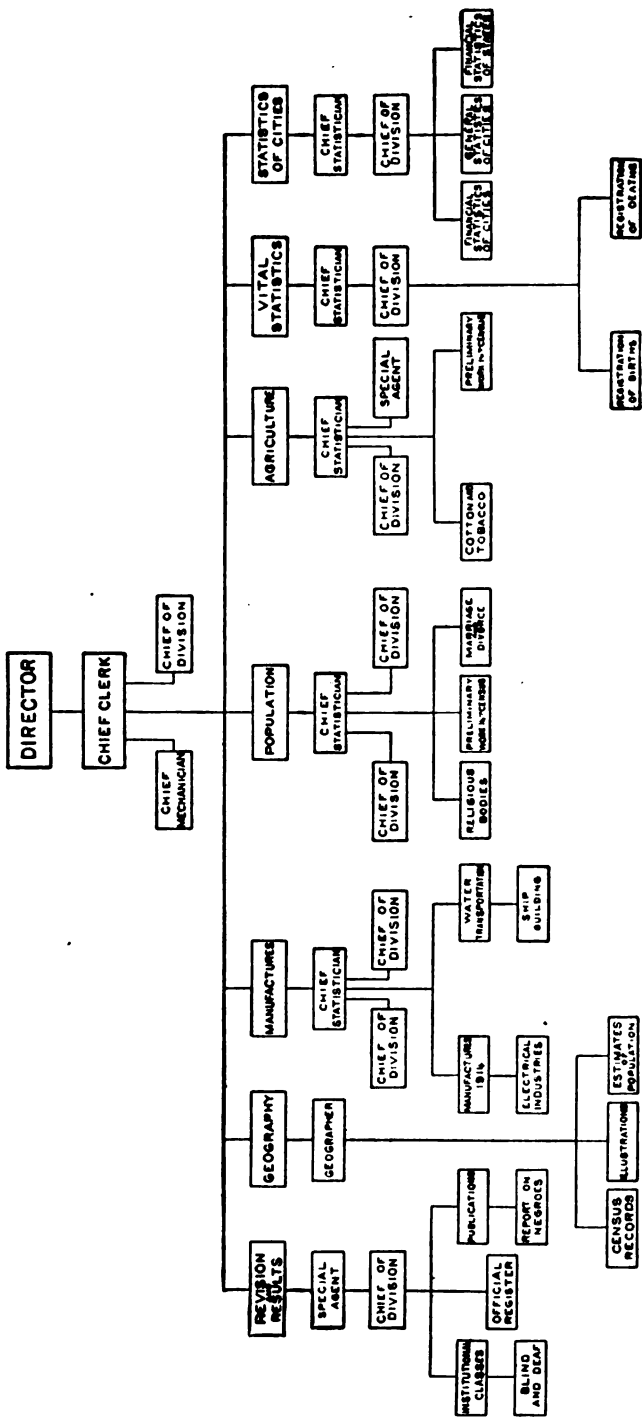
#### **Population Division.**

Collection, compilation, and preparation for publication of decennial statistics relating to population (including occupations) and religious bodies, and of special statistics pertaining to marriage and divorce.

#### **Division of Manufactures.**

Collection, compilation, and preparation for publication of quinquennial statistics pertaining to manufactures and to electrical industries (electric light and power plants, street and electric railways, telegraphs and telephones, and electric fire-alarm and police-patrol signaling systems); and of decennial statistics of mines, quarries, and oil and gas wells, of water transportation and of fisheries (in cooperation with the Bureau of Fisheries).

## ORGANIZATION BUREAU OF THE CENSUS



**Division of Vital Statistics.**

Collection, compilation, and preparation for publication of annual statistics of births and deaths in States and cities having adequate registration systems.

**Division of Statistics of Cities.**

Collection, compilation, and preparation for publication of annual financial and general statistics of cities having more than 30,000 inhabitants; of annual financial statistics of States; and of decennial statistics of wealth, public indebtedness, and taxation.

**Division of Agriculture.**

Collection, compilation, and preparation for publication of decennial statistics relating to agriculture. These statistics are used by the Department of Agriculture as a basis for a large part of its work, including the compilation of estimates of crop acreage and production and of live stock for the years intervening between those in which censuses are taken.

**Division of Cotton and Tobacco Statistics.**

Collection, compilation, and preparation for publication of statistics relating to cotton ginned to specified dates; monthly statistics of cotton consumed, imported, exported, and on hand, and of active cotton spindles; monthly statistics pertaining to cotton seed and its products; quarterly statistics relating to cotton fiber consumed in the manufacture of explosives; quarterly statistics of raw cotton consumed in the manufacture of absorbent and medicated cotton; annual statistics of cotton production and distribution; quarterly statistics of leaf tobacco held by manufacturers and dealers; annual bulletin giving statistics of leaf tobacco held at the beginning of each quarter, together with statistics as to acreage, production, imports, exports, consumption, etc.

**Division of Revision and Results.**

Compilation and preparation for publication of statistics of special classes—such as Negroes, deaf and dumb, blind, paupers, inmates of benevolent institutions, insane and idiotic, and prisoners and juvenile delinquents—from data gathered at decennial censuses; biennial preparation of Official Register of the United States and of statistics relating to Federal employees; and miscellaneous work in connection with printing of all census publications

**Geographer's Division.**

Maintenance of records as to boundaries of supervisors' and enumerators' districts and creation of new districts where needed; maintenance of records as to changes in boundaries of counties, precincts, and municipalities; decennial preparation of Statistical Atlas of the United States; preparation of maps, charts, and diagrams illustrating statistics in census publications; searching of old census records for information in regard to ages and other data concerning individuals; and preparation of population estimates between census years.

**OFFICE FORCE.****Hurtful Effect of Existing Salary Scale.**

Because of its very low and poorly arranged salary scale, the Bureau has been seriously handicapped for years in performing the duties imposed upon it. During the period from July 1, 1916, to September 30, 1917, it lost *89 officials and employees*, or nearly *16 per cent of its entire statutory force*. Some of these persons were among the most highly trained and valuable officers of the Bureau, and it was with reluctance that their transfers to other branches of the Government were approved. However, in view of the greatly increased compensation which they were to receive, the Director of the Census did not feel that he could reasonably stand in the way of their promotion elsewhere when he was unable to offer them any inducement to remain in the Census Bureau. It is exceedingly unfortunate that one branch of the Government has to part with its highly trained and expert employees simply because it can not pay them the salaries they are offered for similar service in other branches. I think it will be admitted that they are worth more to the public service in an office in which they have had years of training than in one in which they have had no experience whatever.

If the Bureau is to retain its well-trained employees for the highly important work of the next decennial census period, which begins July 1, 1919, I can not too strongly urge that provision be made for more positions with salaries in excess of \$1,200 per annum and for a rearrangement of the salary list during the next fiscal year. It is my duty to point out that the great work of the census of 1920 (for which preparation is now being made) can not be efficiently carried on with the working force hampered by the salary list now existing.

This matter is discussed in detail in Appendix B.



**Superannuation.**

On July 19, 1917, the Director of the Census was requested to appear before the Senate Committee on Civil Service and Retrenchment, but as he was obliged to appear before the House Committee on Appropriations at the same time, the chief clerk of the Bureau appeared in his stead. He urged the enactment of an equitable system of retirement legislation, in which both male and female employees would participate on the same basis, and submitted the following table showing the employees of the Bureau, by age groups, for the information of the committee:

Grade.	Under 35.		35 to 50.		50 to 60.		60 to 65.	
	Men.	Women.	Men.	Women.	Men.	Women.	Men.	Women.
Officials.....			7		5		3	
Clerks, \$900-\$1,800, inclusive..	84	24	95	144	53	70	15	6
Subclerical.....	7		5		2			
Machine shop.....	3		10					
Total.....	94	24	117	144	60	70	18	6

Grade.	65 to 70.		70 and over.		Total.		Grand total.
	Men.	Women.	Men.	Women.	Men.	Women.	
Officials.....			1		16		16
Clerks, \$900-\$1,800, inclusive..	10	2	11		268	246	514
Subclerical.....			2		16		16
Machine shop.....			1		14		14
Total.....	10	2	15		314	246	a 560

**SUMMARY.**

Age.	Number.	Per cent of total force.
Under 35.....	118	21
35 to 50.....	261	47
50 to 60.....	130	23
60 to 65.....	24	4
65 to 70.....	12	2
70 and over.....	15	3
Total.....	a 560	100

a On July 1, 1917, there were three vacancies in the statutory force of the Bureau.

There is now no serious loss of efficiency in the Bureau from superannuation, since only 27 employees, or 5 per cent of the force, are over 65 years of age. This is due to the fact that when the

Bureau was organized on a permanent basis, in 1902, an age limit of 45 years was fixed for appointment, except in the cases of Civil War and Spanish War veterans. The situation has also been improved somewhat during the past two years by confining permanent appointments to persons not over 35 years of age.

It will be noted from the above table, however, that 181 employees, or 32 per cent of the force, are over 50 years of age, so that continued failure to enact retirement legislation will result in the Census Bureau having within the next 10 to 15 years a large number of employees whose efficiency will be impaired by age. It is hoped that Congress will provide a system of retirement before the Bureau's force reaches this condition.

#### **WORK DONE DURING FISCAL YEAR.**

During the fiscal year the Bureau of the Census completed the compilation and publication of the primary or fundamental statistics derived from its latest canvass of manufacturing industries, carried on the compilation of more detailed statistics for later publication, and issued the Abstract of the Census of Manufactures and numerous final reports, in bulletin form, for separate States and for separate industries; conducted its regular annual inquiries relating to births, deaths, States, and municipalities; published a report on the blind and brought well toward completion the preparation of reports on the deaf, on Negroes, and on prisoners and juvenile delinquents; published special reports on mortality from cancer and on the cost of city cartage; made quarterly collections and publications of statistics relating to stocks of leaf tobacco; made monthly and semimonthly collections and publications of statistics relating to cotton and cotton seed and its products; performed much work for the Treasury and War Departments and the United States Shipping Board in connection with the preparations for war; complied with many requests for information contained in its records; and began work on its decennial canvasses of religious bodies and water transportation, its quinquennial canvass of electrical industries, and its special canvass of marriages and divorces. The work done along these lines is described under the headings "Current and completed work on statutory inquiries" and "Special and miscellaneous lines of work," which follow.

**CURRENT AND COMPLETED WORK ON STATUTORY INQUIRIES.****Census of Manufactures.**

The last quinquennial census of manufactures, which related to the industrial operations of the complete calendar year 1914, was taken during the year 1915. In order to facilitate the work and permit the publication of the statistics at the earliest possible date, many changes and improvements were made in the methods employed, with the result that not only was the canvass brought to completion more quickly than at preceding censuses, but figures derived therefrom were made public, in the form of press summaries, more promptly than heretofore. The work of compiling and publishing these press summaries, or preliminary statements, began in June, 1915, and was completed in August, 1916. The summaries gave, for States and for cities having 10,000 or more inhabitants, statistics as to number of establishments; proprietors, officials, and employees; horsepower; capital; salaries and wages; cost of materials; value of products; and other items. They also gave similar statistics for 37 industries and special statistics as to materials and products for 63 industries. In all, 852 of these press summaries were issued for the census of manufactures covering the industrial year 1914. The summary giving the statistics relating to all manufacturing industries combined, for the entire United States, was sent to the printer on July 24, 1916, an earlier date, relatively to the period covered by the inquiry, than that on which the comparable figures for any preceding similar census had gone to press.

Tables were prepared and published in pamphlet form covering four census years and giving comparative statistics of manufactures for the United States by geographic divisions, States, and industries. There was so great a demand for these figures that statements for some of the principal industries were issued in multigraphed form in advance of the publication of the pamphlet.

The preliminary figures having thus been published, the clerical force of the Bureau was concentrated, so far as possible, upon preparing the analytical tables and text for the final reports. These are being published first in bulletin form, a separate quarto bulletin being issued for each State and the District of Columbia and for each industry. These bulletins will later be bound together in two or three large volumes. The bulletins for the States and District of Columbia have all been sent to the printer, as well

as 35 industry bulletins, and copy for the remaining 6 industry bulletins will be soon completed.

In addition, an Abstract of Manufactures was published in an octavo volume of 722 pages, giving in condensed form the more important statistics. It contains 223 tables with descriptive text giving brief comments. This abstract is, in some respects, a new departure in census work and has proved to be popular. It differs from the abstracts of the decennial censuses of 1890 and 1900 in that it contains analytical tables, comparative figures for earlier years, and text discussion; it differs from the abstract of the decennial census of 1910 in that it presents the statistics in greater detail and at the same time is more convenient for handling; and it differs from all former abstracts by containing statistics of manufactures only. Since the abstract will supply the needs of most of those using the statistics of manufactures, it was the first volume of the final reports to be issued. It may be purchased from the Superintendent of Documents, Government Printing Office, at 65 cents a copy.

#### **Transportation by Water, 1916.**

The act creating the permanent Census Bureau authorized the Director of the Census to make an inquiry relating to water transportation at decennial intervals. The first inquiry conducted under this authority was made for 1906; the current one relates to the calendar year 1916.

Through the cooperation of the Bureau of Foreign and Domestic Commerce and the American Steamship Association and of collectors of customs and postmasters, it has been possible to conduct the canvass rapidly and to avoid duplication of work.

The statistics for over 70 per cent of the vessels on the Bureau's list were collected by mail and by telegraph. Although this method required the preparation of a large number of blanks, and involved much correspondence, it reduced the expense of field work and facilitated the completion of the census. The field work, begun in March, is now finished. The examining and editing of the schedules is progressing well, and it is hoped to make public the report at an earlier date than that at which the corresponding figures were published for the census of 1906.

Statistics are included relating to the operations of fishing vessels, which were not covered by the inquiry of 1906.

**Census of Shipbuilding.**

A census of shipbuilding has also been taken in conjunction with the 1916 census of transportation by water. As in the case of the water-transportation inquiry, it has been possible to collect a large proportion of the statistics by correspondence. Nearly all the establishments covered by this census have been accounted for, and the schedules are now being tabulated and summarized.

**Electrical Industries, 1917.**

The census of electrical industries covers central electric light and power stations; street and electric railways; telephones, telegraphs, and municipal electric fire-alarm and police-patrol signaling systems. This inquiry has been made at quinquennial intervals, beginning with that for the year 1902, under the authority of the act establishing the permanent Census Bureau, and the current one, therefore, relates to the calendar year 1917. The reports for this census, so far as possible, will be gathered by correspondence. A copy of the returns made for the census of 1912 will be sent to each establishment, together with a blank schedule for 1917, with the request that a similar report be furnished for the current inquiry. Clerks have already been detailed for the work of copying the schedules, and the preparation of index cards containing names and addresses of establishments is now in progress.

**Vital Statistics.**

The regular annual reports presenting statistics on mortality for the calendar years 1914 and 1915 were published during the fiscal year 1917. The report giving birth statistics for the calendar year 1915 was issued early in August, 1917.

Reports giving mortality statistics and birth statistics for 1916 will be ready for the printer about December 1, 1917.

Tests of the completeness of birth registration have recently been made in Kentucky and Virginia, and as a result both States have been admitted to the registration area. Similar tests are now in progress in New Jersey and Indiana, and on their completion other tests will be begun in North Carolina, Ohio, Utah, and Wisconsin. The results obtained so far indicate that the registration area for births will be materially increased during the present year.

The registration of deaths, which, under the Constitution of the United States, is a function of the State and municipal authorities,

is constantly becoming more nearly complete, the registration area having been extended until now it contains over 70 per cent of our population.

The census reports presenting vital statistics maintain a high standard of usefulness, which will be raised still further by the extension of the scope of certain branches of the work, as explained in the section referring to vital statistics, under the heading "Plans for future work."

#### **Financial Statistics of Cities.**

The annual report presenting comparative financial statistics of cities having 30,000 inhabitants or more, relating, in the case of each city, to its latest fiscal year terminating prior to July 1, 1916, was sent to the printer in December, 1916. This report gives detailed statistics as to receipts, expenditures, value of city properties, indebtedness, assessments, and tax levies. In addition, data on governmental organization were collected which show number, terms of office, methods of election or appointment, and annual salaries of specified city officials; form of government under which the city operates; and a condensed history of the modern movement toward perfecting governmental organization.

The purpose of the reports on municipal finance, which have been published annually by the Bureau of the Census since 1902, is to present comparable statistics of cities for the information of city officials, civic bodies, students of economics interested in city management, and citizens who take an interest in questions relating to city betterment. These reports enable the wide-awake citizen interested in the physical and financial welfare of his city to find its weak points by comparing its operations with those of other cities of similar size and situation, and assist the city itself to secure better and more economical administration of its public funds. Better management results in improved health conditions, greater recreational opportunities, and wider scope for educational activities; and more economical administration, whether securing better service for moneys expended or retaining in the city treasury for future use moneys formerly wasted, results in financial benefit to every taxpayer.

The classification of receipts and payments presented in the schedules of the Bureau of the Census has been indorsed by many of the leading civic organizations and has been adopted by the bureaus of statistics in several States.

### **General Statistics of Cities.**

The report on this inquiry, which also refers, in the case of each municipality having 30,000 or more inhabitants, to its latest fiscal period terminating prior to July 1, 1916, was completed in December, 1916, and relates to the subject of recreation. The principal features of this report, which is in great demand, are statistics of parks, playgrounds, museums, and art galleries, zoological collections, music and entertainment, swimming pools and bathing beaches, and other special facilities for recreation.

The report presenting general statistics of cities for 1917, now in process of compilation, will give detailed data on fire departments, covering such matters as organization, equipment, grades and salaries, special training of firemen, appointments, promotions, and pension systems. Another subject to be included is that of specified sources of city revenues; for example, business licenses, business taxes collected without the issue of licenses, special assessments for public improvements, and assessments for street cleaning and sprinkling. Information of this character has been requested by city officials for a number of years. The annual financial statistics reports show the amounts collected from such sources, but not the methods of levying and collecting.

### **Financial Statistics of States.**

The report giving comparative financial statistics for the 48 States and relating in each case to the latest fiscal year terminating prior to July 1, 1916, was completed in March, 1917. The annual reports on this subject, of which the one referred to is the second, are similar in scope to those presenting financial statistics of cities. These statistics are in high favor with the State officials, and the annual visits of the agents of the Bureau to the several States for the purpose of collecting them have great influence in standardizing accounting systems, as in the case of the cities having populations in excess of 30,000, for which similar statistics are published.

### **Cotton and Tobacco Statistics.**

*Cotton and cotton seed.*—During the year the Census Bureau gathered and published statistics relating to cotton ginned; to cotton consumed, imported, exported, and on hand, and active spindles; to cotton seed and its products; and to cotton consumed in the manufacture of explosives and of absorbent and medicated cotton. A total of 39 reports, of which 31 were in the form of

post cards, 6 were multigraphed press statements, and 2 were contained in printed bulletins, were issued during the year.

The reports on cotton seed and its products, issued monthly, those relating to cotton fiber consumed in the manufacture of explosives, issued quarterly, and those on raw cotton used in the manufacture of absorbent and medicated cotton, also issued quarterly, mark the beginning of three new series of reports pertaining to the cotton and cottonseed industries, authorized by the act of August 7, 1916. Statistics relating to cottonseed products and linters obtained were published quarterly prior to the passage of this act under the general authority contained in the legislation authorizing the collection and publication of cotton statistics, but those now being issued at monthly intervals cover the subject in much greater detail.

*Stocks of leaf tobacco held by manufacturers and dealers.*—During the fiscal year the Bureau issued, in the form of post cards, three quarterly reports relating to stocks of leaf tobacco held by manufacturers and dealers. Under authority contained in the act of April 30, 1912, the Bureau had issued reports on this subject at semiannual intervals, but in compliance with the terms of the act of May 10, 1916, these reports have been issued quarterly since October, 1916.

#### **Reports Relating to Special Classes of the Population.**

The report on the blind was published during the fiscal year, and the report on the deaf will be issued in a few weeks. The report on the blind has been commended by specialists on the subject of blindness, as well as by persons engaged in work on behalf of the blind. This report is probably the most thorough statistical treatment of the subject ever published in English. Bulletins presenting the fundamental statistics contained in these two reports were issued some time before the reports themselves.

The special reports on Negroes and on prisoners and juvenile delinquents will soon be published. Bulletins giving the more important statistics contained in these reports have already been issued.

#### **Religious Bodies.**

The census of religious bodies is, under the law, taken at decennial intervals. The current inquiry relates to the calendar year 1916. The report will present, for each religious denomination, detailed statistics in regard to church membership, church property, number and salaries of ministers, Sunday schools, etc.



This census will cover about 204 denominations, comprising 240,000 churches. The statistics for 124 of these denominations are to be secured wholly by mail, for 9 denominations partly by mail and partly by contract, and for the remaining 71 denominations wholly by contract. The first church schedules were mailed on January 4, 1917, and at the close of the fiscal year schedules had been sent to 213,379 churches, while the total number of schedules returned up to that date was 128,991, or about 60 per cent of the number mailed.

#### **Official Register of the United States.**

The Official Register of the United States, which is issued biennially, is now in course of preparation and will be published in December, 1917. (See reference to Official Register, under heading "Legislation needed.")

#### **SPECIAL AND MISCELLANEOUS LINES OF WORK.**

##### **Marriage and Divorce.**

Statistics of marriage and divorce covering the calendar year 1916 are now being collected. The canvass thus far has been conducted entirely by mail.

Statistics pertaining to the subject of marriage and divorce for the 40-year period 1867 to 1906, inclusive, have heretofore been collected and published, and it had been the intention to compile such statistics for the 10-year period 1907 to 1916; but because of the national crisis, as a result of which the Census Bureau has been called upon to do considerable emergency work for other departments whose activities are intimately connected with war preparations, it has been decided to make the current inquiry relating to marriage and divorce with reference to the year 1916 only.

The report will show, among other things, by counties, the number of marriages performed and the number of divorces granted during the year 1916, with detailed statistics for divorces, covering such matters as duration of marriage; cause of divorce; party to which granted, and whether contested; number of children; and whether alimony was asked, and whether granted.

##### **Monograph on Cancer.**

A monograph entitled "Mortality from Cancer and Other Malignant Tumors in the Registration Area of the United States, 1914," was published during the past fiscal year. This monograph presents, in much greater detail than that given in the

annual reports issued by the Bureau, statistics relating to deaths from cancers and other malignant tumors throughout the registration area in 1914. The work was undertaken at the request of the American Society for the Control of Cancer. Both this society and the American Public Health Association are especially interested in the monograph and have been active in cooperating with the Census Bureau in its compilation.

#### **Supplementary Occupation Statistics.**

At times when clerks could be spared from more pressing lines of work, the tabulation of occupation statistics supplementary to those heretofore published as a part of the reports of the Thirteenth Census has been carried on. All information of this character has permanent value in itself; but the main reason for compiling it is found in its affording a measure of comparison with the occupational data to be secured in 1920. This is particularly important in view of the fact that the classification now employed was not in use prior to 1910.

A tabulation showing the marital condition of women gainfully occupied was prepared at the request of the American Labor Association for use in relation to the subject of health insurance, and particularly maternity insurance. The work was completed in March, 1917, and the results were transmitted to the secretary of the above-named association for its information and for use in States where legislative action in respect to health insurance had been taken or was then pending; and a press summary and mimeograph copies of tables were made for the use of the press and correspondents.

Other phases of work on supplementary occupation statistics relate to occupations of the foreign born and of women and children.

#### **Census of City Distribution.**

In my last report I called attention to the importance of city cartage as an element in the total cost of goods to the consumer. On January 3, 1917, a press statement was issued in which were set forth the results of a brief preliminary survey made by the Bureau of the Census in the city of Washington and covering four important classes of commodities—coal and wood, milk, ice, and department-store merchandise. The results of this preliminary survey were sufficiently striking to justify me in directing the Census Bureau to make a further and more exhaustive study of the subject. Unfortunately, the Bureau had not available either

the force or the funds with which to extend the investigation to cities other than Washington; but an inquiry covering gross sales and delivery costs during the year 1916 in 120 carefully selected establishments in this city, representing 17 lines of retail business (some of which did a wholesale business also), together with 8 wholesalers of meat products, was made, the results of which were published on April 21, 1917. On the basis of the results obtained from this canvass, the total transportation and cartage costs applying to commodities for public consumption in Washington were estimated, for the year 1916, at \$15,550,000 (of which amount more than one-half represented cartage costs alone), the total being equivalent to approximately \$40 for each person, or \$190 for each family.

These figures emphasize the importance of the subject, and it is hoped that, at some future time, the Bureau will be in a position to make a more exhaustive canvass, covering a number of representative cities throughout the country.

#### **Edible Vegetable Oils.**

The manufacture of edible oils from seeds other than cotton seed is of recent origin in the United States, only a few concerns engaged in the production of such oils having been reported at the manufactures census covering the year 1914. Because of the rapidly increasing importance of this industry, a special canvass was made for the calendar year 1916, and the results were published in June, 1917, in the form of a press statement in which it was shown that 112 establishments produced during 1916 a total of 262,558,661 pounds of oils from peanuts, mustard seed, kapok seed, rapeseed, sunflower seed, soy beans, walnuts, corn, copra, palm kernels, and olives. The movement to grow soy beans, peanuts, and other oil-bearing seeds and nuts for the production of oil has received a great impetus, and it is believed that several hundred establishments will be engaged in crushing the crops grown in 1917.

#### **Special Census of Population.**

A special census of Shreveport, La., was taken as of February 15, 1917, at local request and expense.

#### **Bulletin on Executive Civil Service.**

The Bureau is preparing a statistical report on the employees in the Federal executive civil service on July 1, 1916. Similar reports were published relating to the years 1903 and 1907. Individual cards to the number of about 300,000 have been filled

out and returned by the different departments and offices of the Government, and are now being edited preparatory to tabulation. This work is being carried on in cooperation with the Bureau of Efficiency, which is utilizing the data as a basis for computing the cost of civil-service pensions.

#### **Assistance Rendered Other Departments.**

*Estimates of population for use of War Department.*—An important piece of work begun by the Census Bureau just before the close of the fiscal year and completed shortly afterward was the preparation of estimates of population for use in connection with the registration of men subject to military duty and with the apportionment of the draft. The first set of these estimates was prepared in May, for use in apportioning supplies of registration cards to the various counties and cities; and the second set, prepared late in June, was based on the registration and was intended solely for use in the apportionment of the draft among the States and their subdivisions. Both sets were prepared at the request of the Provost Marshal General of the War Department.

In making the latter estimates, the Census Bureau was confronted by the necessity of securing the greatest possible measure of justice to each community. The method adopted, therefore, was based on the assumption that the registrants in each community represented a fixed proportion of the population. This proportion for the United States as a whole was determined to be equal to 9.32 per cent; and the population estimates for the various States, cities, and counties were therefore computed by dividing the number of registrants by 0.0932. This method yielded the fairest possible basis for the apportionment of the draft, since the localities whose population was overestimated were those in which there was an excess of men 21 to 30 years of age, inclusive, while the localities whose populations were underestimated were those in which the proportions of men of these ages were smaller than the average.

Any other method which might have been employed would inevitably have resulted in overstating the population of some communities which had relatively small proportions of men 21 to 30 years of age; and the seriousness of the injustice that would thus have been brought about may be realized when the fact is taken into consideration that the proportion which men 21 to 30 years of age, inclusive, represent of the total population is fully three times as great in some localities as in others.

*Allocating enlistments.*—Much work was done for the office of the Provost Marshal General of the War Department in connection with the allocation of enlistments in the Regular Army from April 2 to June 30, 1917, inclusive. The 117,974 men enlisting in the Regular Army during this period represented a portion of the credits to be applied to the gross quotas of the States and their 3,300 subdivisions in the apportionment under the selective draft act.

Other work done for the Provost Marshal General's office included the addressing of franks and envelopes for use in the transmission of registration cards and instructions to governors, mayors, and sheriffs throughout the United States and the computation of the net quotas of the several States and Territories and the District of Columbia in the apportionment of the 687,000 men drafted on the first call.

*Liberty Loan work.*—Many clerks were employed for about a week in addressing envelopes and mailing literature in regard to the Liberty Loan. This work was greatly appreciated by the Secretary of the Treasury.

*Information for Shipping Board.*—Special information was compiled from the 1916 shipbuilding inquiry for the use of the United States Shipping Board, and similar information, together with summaries of wage earners employed in shipbuilding establishments, has been furnished the Department of Labor.

*Total amount of war work done.*—The total time spent by the Census Bureau's force on war work, or work having some bearing on war preparations—including, in addition to that already specified, work for the American National Red Cross, the Department of Justice, and the Council of National Defense, and miscellaneous work for other governmental establishments or for individuals—to September 30, 1917, was equivalent to 4,550 days, or nearly 15 years, for one employee.

*Assistance to Federal Trade Commission in compilation of coal data.*—During the months of August and September, 1917, assistance was rendered to the Federal Trade Commission in connection with the compilation of data relating to cost of production of coal at the mines and to prices at which coal has been sold at retail.

*Ages of pensioners.*—During the fiscal year the Census Bureau received and complied with approximately 3,500 requests from the Pension Bureau for data from enumerators' returns to be used in establishing the ages of pensioners.

**WORK IN MECHANICAL LABORATORY.**

During the year the mechanical laboratory maintained the machines used in the Census Bureau and the Bureau of Immigration, made repairs to computing machines, rearranged the key-boards of 10 pantograph punches to conform to the requirements of the card used by the Eight Hour Commission in tabulating its statistics, and made definite and satisfactory progress on the construction of the tabulating machines to be used in the Fourteenth Census (1920). A new automatic tabulating machine was completed toward the close of the fiscal year, given a practical test in connection with the work of tabulating the mortality cards of the division of vital statistics, and found to be entirely satisfactory and a great improvement over the machine used in the Thirteenth Census (1910). This machine is to be used as a model in constructing 25 tabulating machines for the Fourteenth Census work. Many of the parts of these machines have already been manufactured in the mechanical laboratory or purchased in the open market upon specifications prepared by the Bureau's chief mechanician.

Much experimental work has been done on the sorting machines during the last six months with a view to bringing them to higher perfection. One of the automatic punches used in the Thirteenth Census was rebuilt during the year and will be tested against an improved commercial key punch in order to determine which machine is better adapted to the punching work of the next decennial census.

If the Bureau obtains the necessary appropriations for the next fiscal year, it is planned to have the 25 tabulating machines, 5 extra tabulator bases, and 114 extra counting units of 10 counters each constructed, and 19 card-sorting machines and 5 card-counting machines given a thorough overhauling, by July 1, 1919, the beginning of the Fourteenth Census period.

**Integrating Counter.**

At my request, Congress granted to the Census Bureau, in the legislative, executive, and judicial appropriation act for the fiscal year 1918, \$60,000 for expenditure in the development, improvement, and construction of tabulating machines, and \$30,000 of this amount has been allotted for use in the development and construction of an integrating counter. A machine equipped with an integrating counter differs from the tabulating devices now used by the Census Bureau by adding numbers instead of units.

Several types of integrating machines are now manufactured by private companies, but their use by the Census Bureau is undesirable not only by reason of their cost but also because the control of the tabulating devices used by the Government should not be in private hands.

A force is already working on the development of the integrating counter. The patent situation has been carefully examined, machinery and supplies are being purchased, and other preliminary work has been begun.

A reliable integrating counter will be of great value to the Census Bureau in tabulating the agricultural and manufactures statistics to be collected at future censuses. It can also be made available for other Government services.

#### PLANS FOR FUTURE WORK.

##### **Preparations for the Fourteenth Census.**

The one chief consideration in connection with the Census service which must be kept constantly in mind and given precedence over all others is that less than 20 months will elapse before the Fourteenth Census period begins. If that census is to be a complete success, is to be efficiently taken and the results promptly published—the public has a right to expect both—the Bureau must be ready, must have its decks cleared for action in advance. It is not fair to the Census Bureau to expect it, with a force decreasing in efficiency through the loss of trained and capable members who have resigned to obtain better compensation elsewhere, to do a constantly increasing amount of work. Above all, it is not fair to expect it to undertake the great task of the census of 1920 unless there is a definite change in the salary status and, therefore, in the organization of the service. The Bureau is dangerously near the point where any further increase of work, without an increase in force, will simply mean congestion and delay.

The Census Bureau was made a permanent office primarily to facilitate the work of the decennial censuses. This was to be done in two ways: (a) By maintaining a well-trained administrative and clerical force to serve as a nucleus for the greatly enlarged organization necessary to conduct each decennial census; and (b) by giving careful thought in advance to the details of the decennial census work. The enormous cost and not wholly satisfactory results of taking preceding censuses have been due in part

to the fact that in no case, not even that of the census of 1910, have sufficient time and thought been devoted to the work in advance. It is hoped, therefore, that a salutary change will take place in this respect as regards the Fourteenth Census.

In this connection Director North, in his annual report to the Secretary of Commerce and Labor, under date of December 1, 1907, said concerning legislation for the Thirteenth Census:

The Director of the Census is entitled to at least two years in which to prepare for the greatest single piece of work which the Government undertakes, and in order to make this preparation intelligently and to the best possible advantage, he should know for that length of time just what are the provisions in the law under which the work is to be undertaken.

The Fourteenth Census period will begin July 1, 1919, and will end on June 30, 1922. Realizing the importance of making proper preparations for the taking of the Fourteenth Census, the Director of the Census, on March 20, 1917, issued an order to the officials of the Bureau in which attention was called to this matter, and it was directed that the current inquiries of the Bureau should be finished, as far as possible, and all the preliminary work for the next decennial census practically completed by the beginning of the census period.

In compliance with this order preparations for the Fourteenth Census have already been begun. These preparations include a consideration of the act providing for the Thirteenth and subsequent decennial censuses, with a view to determining whether amendments are required to adapt it to the needs of the Fourteenth Census, and if so, the character of such amendments. They also include revisions of schedules to be used in the several field canvasses, and work in the mechanical laboratory.

Near the close of the fiscal year a committee composed of officers of the Bureau was organized to consider proposed changes in legislation. This committee has since been holding weekly meetings and will continue to do so until it has given thorough consideration to every section of the act providing for the Thirteenth and subsequent decennial censuses.

In making its plans for taking the Fourteenth Census the Bureau has invited and obtained the cooperation of outside statisticians and others interested in census work, and a number of conferences have been held with these authorities, as a result of which valuable suggestions have been obtained.

In making these preparations the Bureau, having in mind the increase in the complexity of the inquiries that has taken place



from census to census, with the result that it has become impossible to complete the work within the three-year period beginning on July 1 of the year preceding that in which the enumeration is made, is alive to the necessity of simplifying its inquiries to the greatest practicable degree and of rearranging its work so as to make possible the completion of the tabulations and the publication of the main reports of the Fourteenth Census by June 30, 1922, as prescribed by law.

### **Vital Statistics.**

*Weekly mortality reports.*—Plans are now being made to issue weekly reports of mortality, which will give within 72 hours after the close of each week the mortality rates of the largest 50 cities in the United States. Such reports will quickly reveal any unusual health conditions in any of our large cities and will serve as an important health index.

*Mortality from tuberculosis.*—A monograph on mortality from tuberculosis in the registration area for the calendar year 1918 will be prepared and published. It was originally intended to issue this monograph for the year 1916, but the work was postponed in the hope of obtaining more definite statements regarding the occupations of decedents. In view of the great mortality from tuberculosis—which until recently exacted a heavier toll than any other cause of death and still leads all others except diseases of the heart (including endocarditis)—a publication of this character, showing the relationship between certain occupations and the prevalence of tuberculosis, will be of unusual value and interest.

*Color and race in relation to births and mortality.*—A monograph on mortality by color and race, with especial reference to birth-places of mothers of white persons, will be published. This monograph will measure the influence of color and race upon mortality rates, as revealed by the population and mortality figures for the calendar years 1910 and 1920.

As the birth-registration area grows and the birth statistics published by the Census Bureau assume a greater national significance, the annual birth-statistics reports will be enlarged and tables will be added to show the influence of race and color upon birth rates and upon rates of infant mortality.

### **Census of Virgin Islands.**

At the request of the Secretary of the Navy and with the approval of the President, a special census of the population,

agriculture, manufactures, and fisheries of the Virgin Islands is ordered to be taken as of November 1, 1917. This census will be less detailed and elaborate than the decennial censuses of the United States, but will cover all important data pertaining to the subjects named.

#### **LEGISLATION NEEDED.**

##### **Registration of Births and Deaths.**

In the matter of birth and death registration the United States has lagged far behind many countries. This is because the registration of vital data has been left to the action of the individual States, many of which have failed to establish and maintain adequate systems of recording births and deaths.

The practice of the Census Bureau is to admit to the "birth-registration area" those States, and to the "death-registration area" those States and those cities in nonregistration States, in which, as the result of tests conducted by the Bureau, it appears that the registration is at least 90 per cent complete and in which the registration laws are such as to give promise of a still more nearly complete registration. In only 13 States and the District of Columbia does the registration of births comply with these requirements. In 6 more States tests are being made, or soon will be made, and the records of some of these States are likely also to be accepted in the near future. But throughout the remainder of the country either there is practically no birth registration at all or the registration is far from complete.

The timeliness of this subject is obvious in view of the registration, on June 5, 1917, of all men between the ages of 21 and 30, inclusive, in compliance with the terms of the selective draft act. In many cases when it became necessary to establish the ages of men in order to determine their liability to draft no records except the census population schedules were available. The decennial population returns as to dates of births, however, by no means afford a satisfactory substitute for records made immediately or within a few days after the occurrence of the births; moreover, they do not cover the cases of children who have been born and have died during the interval elapsing between two successive censuses.

In death registration the United States has made greater progress than in birth registration. Nevertheless, only 26 States, 46 cities in other States, and the District of Columbia maintain mortality records of sufficient accuracy to justify the Census Bureau

in accepting them as authoritative. These States and cities contain about 70 per cent of the total population of the country.

It is highly desirable that the birth and mortality records of every municipality or county should be made reliable, permanent and readily available for reference; and the only way to insure the existence of this condition in all localities throughout the country is to place the matter under Federal control.

Thus far the only legislative action taken by the Federal Government toward the improvement of vital statistics is found in a joint resolution of Congress, approved February 11, 1903, requesting State authorities to cooperate with the Census Bureau in securing a uniform system of birth and death registration. The Census Bureau itself has conducted a propaganda in the interest of better birth and death registration by the States, and has achieved some success. In order, however, that the United States may have complete birth and death statistics, comparable with those of the more enlightened foreign countries, it will be necessary either to provide for comprehensive Federal control and supervision of birth and death registration or to wait until the last one of the 48 States shall enact and properly administer adequate laws for the registration of vital data.

After careful consideration of the subject, therefore, I have come to the conclusion that by far the most satisfactory and effective means to hasten the day when the entire United States shall have adequate registration of births and deaths would be afforded by placing the matter entirely under Federal control and supervision.

#### **Employment of Temporary Clerks, Stenographers, and Machine Operators.**

In view of the facts that many of the Census Bureau's inquiries are made at decennial and quinquennial intervals, and that the amount of work of certain kinds in connection with its annual inquiries varies greatly from month to month, it is highly important, in the interest of good administration, that legal provision be made for the needed elasticity in the clerical and machine-operating forces. A bill (H. R. 2359) authorizing the temporary employment of clerks, stenographers, and machine operators, to be selected from the registers of the Civil Service Commission, has been introduced in the House of Representatives, and its enactment into law is strongly recommended.

**Financial Statistics of States.**

Financial statistics of States are now being collected annually under authority of an order issued by the Secretary of Commerce. Legislative authority for making the inquiry a permanent one is desirable, however, and a bill to provide such authority (H. R. 2358) is now before the House of Representatives. Its enactment into law is recommended. The statistics in question are of great value to State officials and others, who are desirous that the investigation be made regularly hereafter.

**Tobacco Statistics.**

The law providing for the collection of quarterly statistics of stocks of leaf tobacco held by manufacturers and dealers requires that the blanks be mailed 10 days before the date to which the report relates and gives the persons reporting 10 days after that date in which to prepare and forward their returns. The time elapsing between the date on which the blanks are received and that on which they are filled out and returned to the Census Bureau—more than two weeks in many cases—is thus so great that many of them are mislaid or lost, with the result that the receipt of the returns and consequently the publication of the reports are delayed.

The law requires an affidavit, which compels a needless expense in places where there is no deputy collector of internal revenue, who is required to administer the oath without charge. This at times occasions delay, since some wait for a visit from the deputy collector in order to save the expense of making the affidavit before a notary public or other official.

It is recommended that the law be amended (1) to provide for mailing the blanks 5 days, instead of 10, before the date to which the report relates, and to allow only 5 days, instead of 10, after that date in which to prepare and forward the returns; and (2) to empower and require the postmaster or assistant postmaster to administer the necessary oath without expense.

**Official Register.**

I desire to renew the recommendations for changes in the scope of the Official Register of the United States which have appeared in the annual reports of the Director of the Census for the fiscal years 1913 to 1917, inclusive, and to emphasize the necessity for these changes. The law directing the compilation of the Official Register provides that the information concerning each employee in the Government service shall be as of July 1. In order to make

the Register as useful as possible, this law, during the period in which the Register has been compiled by the Bureau of the Census, has been disregarded to the extent that all important changes in the Government service after that date to the time of going to press have been included, so far as practicable; but as the Register can not be issued until more than five months after the date to which the information is supposed to refer, it is, in its present form, even under normal conditions, a very unsatisfactory and incomplete publication. The conditions of the past year have emphasized the necessity for making the recommended changes in the method of publishing the Register. Important services of the Government have been organized since July 1, and although they have been included, there have been many changes in their personnel which it has been impossible to record, despite the fact that every effort has been made to do so. If the material in the Register were confined, as has been recommended, to a presentation of the organization of each of the bureaus and independent offices, with a full list of the administrative and supervisory officials, together with tables showing, so far as practicable, the numbers of employees in the various grades and classes, it would convey all the information concerning Government departments and personnel which should be of general interest.

A bill (H. R. 2354) embodying the desired changes in the scope of the Official Register is now before the House of Representatives, and its enactment into law is strongly urged.

#### **Forest Products.**

In my last two reports I recommended the enactment of legislation providing for the annual collection of statistics of forest products. A bill (H. R. 2357) containing a provision of this character is now before the House of Representatives. Statistics of forest products are of more than ordinary importance at this time, and should be collected and published regularly.

#### **Express Business.**

I renew the recommendation contained in my last two annual reports for the repeal of the requirement of a decennial collection of statistics relating to the business of express companies, now contained in the act of June 7, 1906. It would be an unnecessary duplication of work for the Census Bureau to make decennial collections of these statistics, in view of the fact that annual statistics of the same character are collected and published by the Interstate Commerce Commission.

A bill (H. R. 2353) providing for the repeal of the requirement of law in question has been introduced in the House of Representatives.

#### **Weight of Census Mail Matter.**

It is important that suitable provision be made for the transportation by mail, both to and from Washington, of the Bureau's supplies used in connection with census inquiries, regardless of the size and weight of the boxes in which they are packed. Although the Bureau's needs in this regard are very much greater during a decennial census than at other times, it is nevertheless important that it be authorized at all times to have its mail transported in boxes of suitable and convenient size. To this end the enactment of H. R. 4449 is recommended.

#### **Special Statistical Compilations.**

I also renew the recommendation contained in my last two reports to the effect that express, rather than implied, authority be given the Director of the Census to prepare special statistical compilations, as well as to furnish transcripts of tables and other records, for State and local officials and for private concerns and individuals, and that the provision of law conferring this authority be so drawn as to make the amounts received for work of this character actually serviceable to the Bureau instead of only nominally so as at present. The authority under which the Bureau now performs this work is found in section 32 of the Thirteenth Census act. A bill (H. R. 2360) conferring upon the Director of the Census the desired authority has been introduced in the House of Representatives.

#### **OFFICE ROOM AND STORAGE SPACE.**

Less than two years will now elapse before the beginning of the Fourteenth Census period (July 1, 1919), and it is imperative that early consideration be given to the matter of providing suitable office accommodations for the Bureau during that period as well as adequate permanent storage space for its records.

During the Thirteenth Census period (1909-1912) the greater part of the Census Bureau's force occupied two adjoining buildings and the remainder was housed in two other buildings, one of which was nearly a mile from the main office. The total floor space occupied by the Bureau in these four buildings amounted to nearly 200,000 square feet, and the total annual rental was \$40,000 (no rental being charged for the 8,700 square feet of floor space

occupied in the Maltby Building). The total floor space, exclusive of halls, toilet rooms, etc., occupied by the Census Bureau in the Commerce Building on June 30, 1917, was approximately 74,000 square feet, of which about 8,000 square feet represented storage space.

In view of the fact that the Bureau during the next decennial census will have a force about seven times as large as at present and will need about 275,000 square feet of space, including storage, the impossibility of accommodating it in the Commerce Building during that period is apparent. It would be unfortunate and expensive to have the force split up into four separate elements, as it was at the last census, and the expense for rental then incurred should be avoided. If the war shall, as all hope, be over before the beginning of the Fourteenth Census period, nearly 20 months hence, it is possible that the temporary buildings erected for the Council of National Defense or the use of the two military departments may be made available for the census work. It is probable that in one or another of these, the entire census work, save such as the Director might wish continued in the regular home of the service in the Commerce Building, might be accommodated. The result would be a great saving in cost over the previous period and equally great gain in effectiveness.

The Director urges with force the need of storage space for the census records. Old population schedules contain information of great value to genealogists, applicants for pensions, litigants, and others. By means of them recently ages were ascertained in determining whether certain persons were subject to draft under the law. The destruction or serious injury to the records would be irreparable. They are now stored under such conditions that they are rapidly deteriorating, and some of them have been so injured by rain that portions are obliterated. These conditions form another appeal for the national archives building, in which the records might not only be stored, but be preserved in shape for constant reference and use under expert care.

## BUREAU OF FISHERIES.

(Dr. HUGH M. SMITH, *Commissioner.*)

The report of the Commissioner of Fisheries is a document of unusual present interest. It bears directly upon the important question of conserving and enlarging our food supply and forms an important contribution to the discussion of that subject. It shows that the past fiscal year has been the most successful in the history of that important service.

The Bureau of Fisheries is better equipped than ever in both material and personnel, and through the support given it by Congress it has been able to serve the public more efficiently than in the past. Its outlook for continued increasing usefulness was never so promising.

Upon the entrance of the United States into the war, this Department tendered to the Navy Department the use of its biological stations at Beaufort, N. C., and Woods Hole, Mass. Early in April a marine guard was established at Beaufort for the protection of the radio station on the Department's property, and during the same month office and living quarters were taken at Woods Hole by the commanding officer of the naval section base. By the latter part of the summer most of the facilities of the Woods Hole station had been placed at the disposal of the Navy, and in September nearly the entire Beaufort establishment was turned over. The buildings at both of these places offer excellent living and other accommodations, and their peculiar location renders them excellent section headquarters.

Just after the close of the fiscal year the Secretary visited the Berkshire fish hatchery shortly after the Commissioner of Fisheries himself had been there. This valuable property of about 135 acres, with a remarkably copious supply of good water and ponds and buildings ready for use, was presented to the Government by Mrs. Mary A. Scully in memory of her husband, the late John S. Scully. It is located about 7 miles from Great Barrington, Mass., in the town of New Marlboro. A joint resolution of Congress accepting the gift was approved by the President on July 28, 1916, and soon thereafter active cultural operations began.



It is intended to develop this hatchery so as to largely increase its output.

Attention is directed by the Commissioner of Fisheries to the importance of a comprehensive investigation of the fishery resources of the Gulf of Mexico. Some investigations are now under way, but consideration should be given to the need of a comprehensive and exhaustive survey in the interests of the food supply not only of the States bordering upon the Gulf of Mexico but of the entire country. There is a possibility of facts of material economic importance being developed having commercial bearing in addition to the question of the development of foods.

Alvin B. Alexander, assistant in charge of statistics and methods of fisheries, died on October 31, 1916, and was succeeded by Lewis Radcliffe.

#### **Exploitation of New Aquatic Foods.**

In response to the call for increased production of foods to meet the great present emergency, the Bureau of Fisheries has concentrated its biological and technical activities on lines of work that promise immediate results. It has taken active steps to induce an augmented output of food from aquatic sources, and has achieved marked success in its campaigns to bring about proper utilization of products hitherto wholly or partly neglected by our fishermen, dealers, and consumers.

On June 21, 1916, the President approved a bill authorizing the Bureau of Fisheries to take steps to increase the economic utilization of predaceous fishes, particularly for food, and making an appropriation of \$25,000 for the purpose. The authority granted was general in its terms, but its immediate intent was to promote the use of several species of small sharks known as dogfishes which, on account of their large numbers and predatory habits, have been a source of serious loss to the fishermen through the destruction of fishing gear and the dispersal of the schools of merchantable fishes. The project was to convert this nuisance into an asset by utilizing these fishes for food, a use to which experiments had shown them to be adapted. As the word "dogfish" is applied to at least five unrelated species of fishes and is used as a term of opprobrium, the name of the fish used for food was changed to grayfish, which is descriptive and unobjectionable, and distinguishes the fish from others with which it may be confounded.

The precedent exists in the use of the terms "bluefish," "whitefish," "blackfish," etc.

Arrangements for canning grayfish were made with several packers on the Atlantic coast who, in consideration of selling the product at a reasonable price and keeping the quality to a given standard, were accorded the privilege of using on their labels a statement to the effect that the product was packed at the request of the Bureau of Fisheries and in accordance with methods approved by it. Only one of these companies canned the fish during 1916 and it commenced so late in the season that the schools had left the coast before the desired quantity was packed. In December similar arrangements were made with Pacific coast canners, of whom five packed in commercial quantities, but it was necessary to withdraw from one of these the privilege of using the inscription referred to above for failure to keep the product up to standard.

The campaign to acquaint consumers with the merits of grayfish was so effective that each of the several packers received orders far in excess of his supply. The total pack during the calendar year 1916 was 19,108 cases, or 917,184 one-pound cans. This required about 3,000,000 pounds of fish which, in addition to the food, yielded about 20,000 gallons of excellent oil and a large quantity of fertilizer. Some of the eggs also found a market for currying leather, and experiments to extend their use are being conducted. Thin leather of good quality has been made from the skins.

Dr. P. H. Mitchell, the director of the Woods Hole laboratory, has devised a method for extracting from grayfish eggs acid albumen and oil, both of which are valuable commercial products. It was found in the course of his experiments that crude gelatin solutions could be successfully clarified with a small amount of egg material. Dr. Mitchell also conducted experiments on the extraction of gelatin from grayfish wastes, and found that the wet waste would yield about 2 per cent of pure gelatin.

Dr. Mitchell also tested six species of sharks for food, by having a number of persons eat them, prepared in various ways. The meat was pronounced not only good but especially pleasing in flavor and texture, and it is felt that when once established in the markets these fishes will rank with the swordfish as a commercial product.

The experimental work in curing fish by salting and smoking was continued with favorable results at the Beaufort laboratory.

The cultural experiments at that station with the diamond-back terrapin have progressed with good results. Two lots of young terrapin were liberated, 830 near the Beaufort laboratory and 354 at Port Lavaca, Tex.; 200 have been reserved for experimental purposes and 400 remain for final disposition.

It is doubtful if many people realize the importance of the shrimp fishery. It has grown surprisingly in recent years. The canvass of this industry for 1916 reveals the fact that in that year there was a catch of over 43,900,000 pounds and that over 9,200 persons are engaged in the industry, with an investment in excess of \$2,400,000. Louisiana is the center of the industry. Florida is second, then Mississippi, Georgia, North Carolina, Texas, South Carolina, and Alabama, in order.

Inquiry into the marketing of carp alive has developed the fact that under normal conditions two carloads of carp are shipped each week into New York City, principally from Ohio points. The cars in which they are transported are equipped with tanks. When the cars reach their terminus, the fish are transferred to tanks on automobile trucks and delivered to retailers, who in turn keep the fish in tanks with running water.

In April, 1917, the Bureau of Fisheries undertook to introduce the burbot into markets readily supplied from the region of the Great Lakes. A supply of display cards recommending the fish was sent to dealers and fish-producing companies in Great Lakes ports, and in the following month there was issued a circular giving a brief account of the fish and recipes for cooking it. The display cards were distributed by the wholesalers to the retail trade, and the circulars were furnished to the latter for distribution to the consumer. The burbot is a relative of the cod, inhabiting the Great Lakes and other large bodies of fresh water of the northern part of the United States. It has been improperly called eelpout, and although occasionally eaten by the fishermen, was neglected in the markets. The Bureau's advertising campaign has induced its use in the cities of the Middle West, and it is now on sale in many places where it was unknown; partial statistics show that upwards of 500,000 pounds were sold between April 1 and July 31. As the fish is predatory in its habits, its capture is desirable not only on account of the food it furnishes but for its effect on the supply of other fishes on which it feeds.

The sablefish, formerly incorrectly called black cod but renamed in the interest of accuracy, is one of the best and most abundant marine fishes of the Pacific coast, but its merits have been known

to only a limited number of persons living near the fishing ports. Early in 1917, the Bureau began to advocate the use of this fish, and when the fishing season opened there was a material increase in the quantity brought in by fishermen. At Seattle, 1,146,700 pounds were landed between April 1 and July 31, and large quantities were taken to Tacoma, San Francisco, and other places in Washington, Oregon, and California. Over 2,000,000 pounds of the frozen fish and 1,304,000 pounds of the fresh fish were disposed of by dealers by June 30. During the summer there was greatly increased activity in the sablefish fishery in Alaska, but the quantity taken there can not be determined until the end of the calendar year. The fish is firmly established in the markets under its new name, and will be a factor in the fresh-fish trade during the coming year.

The tilefish has maintained the popularity established during the fall of 1915; in the year ended June 30, 1917, 11,641,527 pounds were landed and entered into consumption.

One of the large and important sources of food that has been almost untouched in America is the class of animals known as cetaceans, comprising the porpoises, dolphins, and whales. A single whale, such as is taken in the shore fisheries of the Pacific coast, yields 3 to 5 tons of select meat comparable to beef and several more tons of other meat. Following the Bureau's advocacy, in personal interviews of officials, in correspondence, and in printed form, of the use of these creatures as human food, there has been much interest manifested in the matter by the whaling companies; there is good reason to believe that this kind of meat, in both fresh and preserved states, will soon become a staple. In May, 1917, fresh whale meat was placed on the Seattle market at 10 cents a pound and met with ready sale. It immediately appeared on the bills of fare of hotels and clubs under its proper name and was very well received. In September, 1917, the Department was advised by a whaling company on the northwest coast that whale meat was finding such a ready market that the company expected great difficulty in supplying the demand, and as this is written whale meat is being served daily in the principal hotels of San Francisco and Seattle and has been tried and approved by leading New York hotels.

### One concern in the whaling business advises:

With reference to edible whale meat: Our efforts to market this produce have met with considerable success, considering that we were not in a position to handle this in a satisfactory manner until our season was more than half over. Our cold-storage plant was not completed until the 1st of August. Altogether this year to date we have sold 247,000 pounds, our principal markets being Seattle and San Francisco. Recently we have shipped to San Francisco two carloads of meat.

Another concern employing several steamers in the trade advises that they are—

operating a modern whaling industry \* \* \*.

The meat of the whales when freshly killed and immediately handled furnishes a very good edible product. A steady demand on the Pacific coast from hotels and restaurants has been developed, and samples brought east in refrigerator cars have been distributed to quite a number of the best hotels in New York City and elsewhere. It has been tried by their proprietors and stewards, who have reported that it is a very good quality of meat and that they are desirous of putting it upon their menus and (are) asking us if we can furnish regular supplies.

These whales on the Pacific coast are very large, and while we have not at the moment statistics as to the average amount of edible meat per whale, the catch of whales during the past summer season was over 600, and as they are many tons weight each the addition to the food supply of a successful winter fishing season would be very large and extremely valuable in these times.

### Aid to the Fishing Industry.

Among the most important means of augmenting the supply of food products from the water and of preventing the waste of those products is the preservation by appropriate methods of that part of the catch which can not profitably or conveniently be sold in a fresh condition. On many parts of our coasts and on our lakes and interior streams the fishermen could at times dispose of all or part of their catch to better advantage by salting or smoking than by selling it fresh or shipping it in ice; but through lack of initiative or through ignorance of the market value of preserved products and of the methods of preparation best adapted to the different kinds of fish, little or nothing is done.

Through the employment of technical experts in preparing and preserving fish and by means of widely disseminated printed matter, the Bureau has actively entered this field, although handicapped by the small force of available assistants; and by personal interviews with fishermen and practical demonstrations of approved methods of curing, has very materially added to the stock of fishery foods that will come into use during the off season or will be available for sections remote from sources of supply. This work has been made of peculiarly practical value by the employment by the Bureau of experts versed in the Norwegian

and Scotch methods of fish curing, whose efforts have led to the preparation of large quantities of fish food according to the best practices of the trade.

In view of the large opportunities afforded by the conditions in Alaska for materially adding to the supplies of foods through the increased utilization of the aquatic resources, on April 21, 1917, the following letter was addressed to the people of Alaska and sent broadcast to newspapers, chambers of commerce, fishing firms, and individuals in the Pacific Coast States and in Alaska:

In his recent letter to the American people the President has eloquently and clearly presented the duty and privilege of every citizen to rally to the support of the country in the emergency now confronting it. He laid particular emphasis on the opportunities afforded those, who for various reasons may not be able to join the fighting forces, to render other service no less necessary and laudable, especially in increasing the supply of foodstuffs of which under the stress of war there is likelihood of a dearth. It is necessary that the present sources of food supply should be maintained and new sources created and developed in order to provide well-fed men for the conduct of actual military operations. The success of the unselfish undertaking in which the country has embarked is dependent on each one of us performing his full patriotic duty in the field in which he can be used most effectively.

Alaska came under the flag at the close, and largely as a result, of one great conflict, and it has just completed its first half century of useful Americanism on the eve of another. It is peculiarly fitted, by reason of its great natural resources and the enterprise of those who do business within its borders, for rendering further and inestimable service at this critical time in the country's history, and I am confident that it will respond to the call of duty and opportunity.

It is probable that there will be difficulty in materially increasing the yield of some of the fisheries of the Atlantic coast on account of the demand for small vessels for military purposes. Alaska's duty arises from the fact that it is absolutely necessary to increase the total yield of the fisheries, and her opportunity lies in her possession of vast unutilized fishery resources. The salmon fisheries in many places are being prosecuted as intensively as is permissible with due consideration to the danger of overfishing and the maintenance of the future supply, and moreover are so well organized that they will undoubtedly be conducted vigorously during the coming season, but there are other fishes in abundance which are not used as they should be.

The most important of these is the herring, which is widely distributed and in quality is equal to that of the Atlantic. The demand for this fish, pickled, is growing rapidly. The sable fish (black cod), for which the Bureau of Fisheries is establishing a large market, fresh, frozen, and kippered, is one of the finest of American food fishes and exceedingly abundant in southeastern Alaska and contiguous waters. The atka-fish, frequently called "atka mackerel" and "attu mackerel," is regarded by many as superior to the true mackerel when pickled in the same manner.

All of these fishes lend themselves to preservation by salting, and in view of the dearth of tin plate, which may interfere with any large increase in the pack of canned fish, I can not too strongly urge that large quantities of all of them be cured during the coming season. There is no doubt that the demand for them will be heavy next winter, and the Bureau of Fisheries will take steps to make the public acquainted with their merits. The Bureau's agents in Alaska will lend fishermen and salteries all possible assistance, and information concerning methods of curing will be furnished to those desiring it.

Aside from service rendered to the country, there is now presented an unusual opportunity to enlarge and broaden the fishery industries of Alaska, for a market established at this time is certain to be maintained when peace comes. Now is the time to act.

Supplementing this letter, the Bureau sent to Alaska one of the best experts in the country to give instruction to the fishermen in the most approved ways of curing fish and to impart the necessary information to seven other employees who in turn served as instructors to fishermen. The Bureau also addressed an appeal to about 100 fish packers on the Pacific coast, urging them, in view of the shortage of tin plate, to make the largest possible output of fish prepared in other ways than by canning, and expressing a desire to assist them in every feasible manner in obtaining the necessary materials and marketing their pack. The practical aid thus rendered by the Department and the Bureau comprised an arrangement with coopers for a prompt supply of barrels, the enlistment of the cooperation of steel makers in Pennsylvania for a prompt supply of hoops to the coopers, the enlistment of the assistance of the committee on transportation of the Council of National Defence for the prompt movement of hoop steel across the continent, an arrangement with salt producers on the Pacific coast for prompt supplies of salt, and an arrangement with Alaskan transportation companies for the quick movement of barrels and salt to the fishing districts. One result of these efforts was the preparation of at least 25,000 barrels (5,000,000 pounds) of Scotch-cured herring in addition to a very substantial pack of herring by other methods.

#### **New Aquatic Sources of Leather.**

Formerly large quantities of the untanned skins of sharks were used for polishing wood, ivory, and other substances. Shark skins and the skins of other fishes have had a limited use for ornamental and novelty purposes. The scarcity and high price of mammal hides and the lack of an established market for fishskins led the Bureau to investigate the possibilities of producing satisfactory fishskin leathers. A regular market now exists for shark and porpoise skins for use in making leather, and several houses are engaged in the business.

Congress passed an act approved June 12, 1917, carrying an appropriation of \$10,000 to enable the Bureau of Fisheries, in cooperation with the Bureau of Standards, to develop new aquatic sources of leather supplies. This authority will enable the Bureau of Standards to conduct experiments in overcoming special diffi-

culties connected with the tanning of fishskins into leather and the Bureau of Fisheries to carry on exploitation work among fishermen, tanners, and manufacturers in its effort to establish and promote this new branch of the fishing and tanning industries.

In order to stimulate the interest of the tanners in developing tanning processes suited to fishskins, the Bureau has furnished them with the hides of several hundred sharks and other fishes, including cod, hake, grouper, gar, ray, catfish, and wolffish, and has advised them of possible sources of supply of raw products. The larger samples of leather tanned from these skins submitted have been tested as to tensile strength by the Bureau of Standards and the resulting data have been made available for comparison with other leathers. Fishermen have been furnished with instructions in the preparation of the skins for the tanners and advised of possible markets for the skins, and experiments have been conducted looking to the simplifying and shortening of the time required to remove the skins.

Recently, following these activities, several tanners have announced that they have developed processes by which fishskins may be tanned into good grades of leather and that they are in the market for the raw products. The uses to which these leathers are best suited, their value in competition with other leathers, and the ability of the raw products to command values sufficiently large to enlist the cooperation of the fishermen in saving and marketing them, have not yet been finally determined, but the Department is advised that a number of firms are placing orders for unlimited quantities of salted shark skins at 10 to 15 cents a pound to the fishermen.

### **Fur Seals.**

A census of the seals resorting to the Pribilof Islands was taken in the summer of 1917 after the methods heretofore followed, but was made especially difficult by the increased number of newborn pups, the pugnacity of the bulls, and the inadequacy of transportation facilities between the islands during the short period within which the counts of the various classes of seals have to be made. The actual enumeration of the pups, which is the most accurate guide to the strength of the herd, could not be fully carried out on some of the rookeries, but the count as a whole appears to have been sufficiently complete for practical needs. The revised census figures, which are subject to slight further revision as the voluminous data are carefully studied, indicate that in 1917 there were



approximately 468,692 fur seals of all ages in the Pribilof herd, that 128,024 pups were born in the summer of 1917, that the average number of cows to a harem was 26, and that the bachelors and idle bulls numbered over 104,000. It is the great preponderance of mature and young males that demands and will receive the close attention of the Department.

The final annual payments of \$10,000 each to the Governments of Great Britain and Japan have been made under the sealing convention of July 7, 1911, and from August 24, 1917, those nations will be entitled to a share of the annual take of sealskins amounting to 15 per cent in each case.

The food requirements of the seal-island natives during the calendar year 1917 was fixed at 7,500 seals, the same as in 1916, when 6,468 were actually taken. It was, of course, expected that a part of those requirements would be met by the seals taken for commercial purposes.

The Department has every reason to be satisfied and gratified at the outcome of its efforts to establish the Alaska sealskin industry in America. The newest feature of the business is the dressing, dyeing, and machining of the Government skins before they are offered for sale. This has met with the hearty approbation of the trade, and in addition has been pecuniarily advantageous to the Government.

During the past fiscal year there were sold by Messrs. Funsten Bros. & Co., of St. Louis, agents of the Department, 5,400 fully dressed and dyed sealskins at three regular auction sales. The gross price received was \$236,748.50, and the net returns to the Government were \$165,793.18.

Blue-fox skins, an incidental product of the Pribilof Islands, have been taken under careful supervision. The herds are in flourishing condition, and the stock is improved by judicious thinning, in view of the limited natural food available for the foxes. The skins taken in the winter of 1916-17 were brought from the islands in August, 1917, by the *Roosevelt*, and sold in St. Louis at public auction in October.

Acknowledgment is made of assistance rendered by the Navy Department to the Department of Commerce in the maintenance of radio stations on the Pribilof Islands, Alaska. These stations greatly facilitate the administration of affairs incidental to the fur-seal and fox herds. Acknowledgment is also made of the courtesy extended by the Navy Department in the transporta-

tion from Seattle to the Pribilofs in the spring of 1917 of approximately 300 tons of supplies on the radio station tender *Saturn*.

The Department expresses also its appreciation of the continued cooperation of the Coast Guard in the transportation of supplies and persons in connection with operations at the Pribilof Islands. The duty of maintaining a patrol for the protection of the fur-seal herds falls upon the Coast Guard. This service has been performed so efficiently that there were no indications whatsoever this year of illegal or pelagic sealing. Were it not for the assistance rendered by the Coast Guard, the effectiveness of the Department's work in respect to the Pribilof Islands would be greatly lessened.

By reason of the marked increase in the cost of the necessary supplies for the Pribilof Islands, we had to ask Congress for an additional appropriation of \$35,000 in May last. At that time the following correspondence took place and is incorporated here with accompanying tables as a matter of public record:

DEPARTMENT OF COMMERCE,

OFFICE OF THE SECRETARY,

*Washington, May 26, 1917.*

DEAR MR. SECRETARY: There is transmitted herewith, to be submitted to Congress in accordance with existing law, an estimate in the sum of \$35,000, to cover a deficiency in the appropriation for protecting seal and salmon fisheries of Alaska, 1918, arising under the following circumstances:

The estimate originally submitted to Congress by this Department for an appropriation under this head for the fiscal year 1918 was in the sum of \$100,000. The appropriation covers the cost of furnishing supplies, fuel, food, and clothing to the native inhabitants of the seal islands of Alaska, and the protection and regulation of the fur-bearing animals and fisheries of Alaska.

When the estimate was originally made \$60,000 was allowed for supplies for the native inhabitants on the fur-seal islands. The appropriation under this head made by Congress was in the sum of \$75,000.

Proposals actually received in the Bureau of Fisheries for these supplies, for the fiscal year 1918, on schedules containing only the absolutely essential supplies and on minimum quantities, show the cost for 1918 to be \$72,000, thus leaving only \$3,000 for all other obligations payable from this appropriation; in other words, leaving \$3,000 for all of the work of protecting and regulating the fur-bearing animals and fisheries on the Alaskan mainland, and all incidental expenses connected therewith.

The proposals for supplies for the fiscal year 1918, indicate that in the fur-seal islands also the high cost of living causes an increase in the cost of maintenance of the native inhabitants of Alaska. The only maintenance which the natives of the Pribilof Islands receive is that furnished by the Government. The islands produce nothing in the line of food, fuel, or clothing. The situation is such that the supplies must all be purchased at one time, and taken to the islands in the summer, because, owing to climatic and weather conditions, vessels can not land on these islands except under the most favorable circumstances. This makes it urgent that the deficiency appropriation be promptly made.

I am inclosing herewith a statement showing in detail increases in some of the classes of supplies contracted for. This statement shows the contract price of the purchases made in 1915 and 1916, and the proposal prices for the purchases to be made this year.

I also inclose a statement showing estimates of expenses chargeable against the Alaska appropriation during the fiscal year 1918. In this statement the amount of supplies, \$72,000, is the actual figure furnished by the proposals received.

In making this request for an additional appropriation I am making no request for disbursement of funds for which the Government gets no direct returns. During the four fiscal years from 1912 to 1915 the Bureau of Fisheries expended in connection with the Alaska service \$243,093.28. The amount received by the Treasury Department from fish taxes alone was \$556,767.94. During this period the Alaska fisheries yielded products having an average annual value of upward of \$19,000,000. Beginning with 1910, the first season when the Government assumed direct control of the seal and fox herds and discontinued the leasing system, the Pribilof Islands to May 1, 1917, have yielded the Government net returns in seal and fox skins aggregating \$1,506,728. Against this the operating expenses, amounting to \$698,247, are placed, showing a net income to the Government during this period of \$808,481.

The receipts and expenditures are shown in detail in the table below.

COMPARISON OF EXPENDITURES AND RECEIPTS IN PROTECTING THE SEAL FISHERIES OF ALASKA FROM MAY 1, 1910, TO MAY 1, 1917, INCLUSIVE.

Designation of expenditures and receipts.	Total for period of 7 years.	Yearly average.
Net receipts skins sold.....	\$1,248,682	.....
Net value of 7,957 sealskins in storage at St. Louis, Mo., May 1, 1917, at \$32.43 each <sup>a</sup> .....	258,046	.....
Total value of and net receipts from skins.....	1,506,728	\$215,247
Total operating and other expenditures to June 30, 1916 <sup>b</sup> .....	698,247	99,750
Net receipts over expenditures.....	808,481	115,497

<sup>a</sup> This is the average net price per skin received in sales of January and April, 1917.

<sup>b</sup> Includes cash payments to Great Britain and Japan aggregating \$80,000.

Very truly, yours,

WILLIAM C. REDFIELD,  
Secretary.

The SECRETARY OF THE TREASURY,  
Washington, D. C.

*Estimate of expenses chargeable against Alaska appropriation in the fiscal year 1918.*

Pribilof Islands:

Supplies, as per bids.....	\$72,000
Services, janitors, natives, etc.....	3,500
Travel of Pribilof employees.....	2,000
Purchase of ordnance.....	800
Reestablishment of stations and markers for census work on rookeries.....	500
Purchase of sealskin tags.....	500
	<hr/> \$79,300

## Protection of salmon fisheries:

Travel and subsistence, 10 agents and wardens.....	\$8,000
Temporary services, boatmen, guides, special wardens, etc.....	2,000
Equipment and supplies.....	1,000
Removal of natural barriers in salmon streams.....	3,000
Hire of small boats.....	2,000
Maintenance of Bureau's patrol boats.....	4,500
	<u>\$20,500</u>

## Fur-bearing animals:

Travel and subsistence, 7 agents and wardens.....	6,000
Temporary services, guides, special wardens, etc.....	1,500
Equipment and supplies.....	1,500
	<u>9,000</u>

Miscellaneous: Freight, express, telegrams, etc..... 1,200

Total..... 110,000

This statement does not include the cost of maintenance of a vessel or vessels for the transportation of supplies to the Pribilof Islands or the transportation of products from the islands.

PRICES PAID FOR VARIOUS SUPPLIES FOR PRIBILOF ISLANDS FOR YEARS 1915 AND 1916, AND PRICES QUOTED ON SAME SUPPLIES FOR 1917.

Nature of supplies.	1915		1916		1917	
	Quantity.	Unit price.	Quantity.	Unit price.	Quantity.	Unit price.
<b>Shoes:</b>						
a. Baby.....pairs.....	124	\$0.50	150	\$0.57½	146	\$1.10½
b. Misses'.....do.....	118	1.35	102	1.55	108	2.10
c. Women's.....do.....	168	1.05	162	1.80	166	3.00
d. Men's calf.....do.....	144	2.25	120	2.50	154	3.35
e. Boy's calf.....do.....	174	1.50	150	1.75	204	2.37
<b>Vegetables:</b>						
a. Potatoes, Irish.....pounds.....	24,500	.025	25,500	.01¾	27,000	.03
b. Potatoes, sweet.....do.....	500	.06	500	.03	500	.10
Sugar: Granulated.....do.....	9,000	.06¾	5,600	.082	5,600	.10
Flour.....do.....	65,000	.031	59,000	.026	60,500	.066
Corn meal.....do.....	8,000	.018	7,000	.026	2,000	.05
<b>Canned goods:</b>						
a. Apples.....cases.....	35	2.64	40	2.80	40	6.00
b. Peaches.....do.....	110	2.20	80	2.30	85	4.00
c. Beans.....do.....	20	3.84	50	3.90	100	7.00
d. Corn.....do.....	72	1.65	25	2.20	80	4.00
e. Tomatoes.....do.....	65	1.55	90	1.80	100	3.80
f. Soups.....do.....	29	3.40	55	3.60	85	5.50
<b>Salted meats:</b>						
a. Bacon.....pounds.....	650	.2145	500	.2397	500	.41¾
b. Ham.....do.....	1,625	.169	1,225	.2147	1,225	.31¾
Oleomargarine.....do.....	12,100	.175	10,800	.1745	11,400	.2723
<b>Dry goods:</b>						
a. Wash goods, dress.....yards.....	1,000	.08½	1,400	.08½	1,500	.13¾
b. Thread, cotton.....dozen.....	180	.48	128	.48	280	.52½
c. Gingham.....yards.....	3,000	.07½	2,250	.09½	2,200	.12½
d. Blankets, woolen.....each.....	22	6.00	52	8.00	42	8.80
<b>Hardware:</b>						
a. Cartridges, 22 long.....	15,000	a 3.10	10,000	a 3.79	10,000	a 5.14
b. Shot, No. 4.....pounds.....	2,500	b 7.49	1,900	b 10.40	400	b 12.00
c. Black powder.....do.....	1,000	b 38.79	600	b 48.50	600	b 65.00

a Per thousand.

b Per hundredweight.

*Estimates of appropriations required for the service for the fiscal year ending June 30, 1918,  
by the Department of Commerce.*

DEPARTMENT OF COMMERCE—BUREAU OF FISHERIES.

*Protecting seal and salmon fisheries of Alaska, 1918—*

Alaska, general service: For protecting the seal fisheries of Alaska, including the furnishing of food, fuel, clothing, and other necessities of life to the natives of the Pribilof Islands of Alaska, transportation of supplies to and from the islands, expenses of travel of agents and other employees and subsistence while on said islands, hire and maintenance of vessels, and for all expenses necessary to carry out the provisions of the act approved April 21, 1910, entitled "An act to protect the seal fisheries of Alaska, and for other purposes," and for the protection of the fisheries of Alaska, including travel, hire of boats, employment of temporary labor, and all other necessary expenses connected therewith (acts Mar. 3, 1893, vol. 27, p. 585, sec. 1; Feb. 14, 1903, vol. 32, p. 827, sec. 4; July 1, 1916, vol. 39, p. 323, sec. 1).....	\$35,000
Amount appropriated for the fiscal year for which the appropriation is required.....	
	<u>75,000</u>

Pribilof Islands:

Supplies, as per bids.....	\$72,000
Services of natives, janitors, etc.....	3,500
Travel of Pribilof employees.....	2,000
Purchase of ordnance.....	800
Reestablishment of stations and markers for census work on rookeries.....	500
Purchase of sealskin tags.....	500
	<u>79,300</u>

Protection of salmon fisheries:

Travel and subsistence, 10 agents and wardens.....	8,000
Temporary services, boatmen, guides, special wardens, etc.....	2,000
Equipment and supplies.....	1,000
Removal of natural barriers in salmon streams.....	3,000
Hire of small boats.....	2,000
Maintenance of Bureau's patrol boats.....	4,500
	<u>20,500</u>

Fur-bearing animals:

Travel and subsistence, 7 agents and wardens.....	6,000
Temporary services, guides, special wardens, etc.....	1,500
Equipment and supplies.....	1,500
	<u>9,000</u>

Miscellaneous: Freight, express, telegrams, etc..... 1,200

Amount estimated for..... 110,000  
Amount appropriated..... 75,000

Deficiency..... 35,000

The appropriation was made in the bill signed October 6, 1917.

**Fur-Seal By-Products.**

The continued increase of the Alaskan seal herd and the expiration on August 24, 1917, of the closed season for commercial killing have imposed on the Department a great responsibility

in the matter of conserving and utilizing the seals and of making proper disposition of the carcasses of the surplus males whose skins have been removed. The food requirements of the natives with regard to seal meat are limited, and in the past, during periods of commercial sealing, enormous quantities of valuable food and other materials have been wasted. The Department will now spare no effort to save and dispose of all parts of the seal carcasses, and arrangements to this end are actively being made. Overtures have been received from private firms for the privilege of exploiting the products of the sealing industry hitherto wasted, and by another season the Department will have determined whether it is more advantageous to the Government to lease this privilege or to keep it within its own immediate control.

Among the most valuable fur-seal by-products are the bones. The analysis made by the Bureau of Soils, Department of Agriculture, showed that these bones contain from 24.85 to 25.26 per cent of phosphoric acid and from 4.57 to 4.80 per cent of nitrogen. Reports from the islands indicate that the bone deposits actually in sight represent about 6,000 tons, with some former killing grounds omitted. The natives have been employed, whenever the exigency of the sealing operations and the conditions of the ground would permit, in collecting the bones, which are prepared for shipment by being put through small crushing machines, to save cargo space. They are then packed in the sacks in which coal has been delivered. A number of small lots of bones have been brought from the islands, and a lively interest therein has been shown by fertilizer manufacturers and dealers in all parts of the country. Some hundreds of tons of bones have already been made available for shipment and many bids for the product have been received. In the summer of 1917 the Department accepted an initial or preliminary offer of \$30 a ton for bones delivered alongside the dock at Seattle, and a similar price may be expected for all bones brought from the islands within the next few years. On the first trip of the *Roosevelt* from the islands in August, 1917, loaded with seal and fox skins and blubber oil, there was a lot of seal bones, aggregating 33,000 pounds, which were delivered to a jobber at \$20 a ton, for experimental purposes, in accordance with a previous agreement. That vessel brought also 4,882 salted sealskins and 606 fox skins, 25 casks of seal blubber (7,574 pounds) for use in dressing sealskins, and 3,500 salted seal gullets. It is the intention to utilize the steamer *Roosevelt* in bringing bones on every return trip from the islands.

With a view to determining the commercial possibilities of canning the flesh of fur seals, an experimental pressure cooker has been sent to the Pribilof Islands, and arrangements have been made for corning a supply of meat, the shoulders being especially suitable for this treatment. The flesh is nutritious and palatable, and is eaten not only by the natives but is served regularly at the mess of the Government employees on the islands.

Other parts of the fur seal which have commercial value are the gullet, from which an excellent grade of light, durable leather may be made; the blubber, from which a high-grade oil is obtainable that is serviceable in the dressing of leather; the liver and other organs, which yield a good oil; and the remainder of the carcass, which is convertible into a valuable fertilizer. It is furthermore altogether possible that some of the internal organs, particularly the ductless glands, may yield important food or medicinal extracts.

#### **Use of Driftwood on Pribilof Islands.**

With the view to supplementing as far as possible from local sources the supplies sent to the Pribilof Islands for the support of the natives and to economize on one of the principal items of expense for those natives, namely, fuel, the Bureau of Fisheries has for several years required that supplies of driftwood be gathered by the natives on the shores of the islands. The supply of such wood is necessarily irregular; it is more abundant on St. George Island than on St. Paul Island. It is used as an auxiliary fuel, particularly for cooking in summer. Beginning in December, 1915, and continuing through the summer of 1917 there were collected on the two islands 340 cords of driftwood. This is a supply hitherto wasted. It is the intention to continue this practice and if possible to extend the collections. All the available wood on the shores convenient to the villages is now gathered, and larger collections on other parts of the islands might be made but for the absence of transportation facilities. The construction of roads and the use thereon of automobile tractors and other vehicles will permit taking larger quantities of driftwood and will also promote other local industries.

#### **Reindeer on the Pribilof Islands.**

From a small number of reindeer placed on the seal islands in 1911 there has grown a herd which in August, 1916, numbered 196 animals of all ages.

**Need of a Power Barge for the Pribilof Islands.**

A power derrick barge is greatly needed at the Pribilof Islands for use in loading and unloading vessels, in transporting supplies between the islands and, if necessary, to make trips as far as Unalaska, a distance of 250 miles. There are occasions when it is necessary to transport a number of natives or workmen, agents and officers of the Bureau between St. Paul and St. George Islands or between either or both of them and Unalaska. A vessel of this type could perform this service at much less expense than is possible with the larger steamers now occasionally used when available for the purpose, and would save many delays that now necessarily occur in waiting for vessels. There is at present no way of getting from one island to the other or to the nearest port save when a Coast Guard or other Government vessel happens to be on hand. Much important work is delayed on this account and all the evils exist that are normally incident to the entire absence of means of transportation under control of the Government officers stationed at the islands.

The proposed power barge should be about 75 feet long, 18 feet broad, with an internal-combustion engine of about 120 horsepower, capable of carrying, say, 25 tons of cargo and a small number of persons, with a crew of four or perhaps five men. The estimated cost of the barge or tender is \$20,000. The vessel would more than pay for its cost and maintenance in the saving of time of the large vessels which now have to be loaded and unloaded at small native posts. An estimate for the above-named amount will be submitted to Congress.

**General Activities of the Bureau.**

The work of artificial propagation and distribution of food fishes established a new record in 1917, when the output of more than five billions was about three hundred millions in excess of the best previous year. The unit cost of the fish-cultural operations reached its lowest figure, namely, \$114.46 per million, as against \$117.86 in 1916, \$146.36 in 1910, and \$239 in 1905.

In distributing the product of the hatcheries, the special fish cars ran 138,717 miles and the detached car messengers traveled 554,597 miles. The new steel car, for which Congress appropriated \$20,000, was completed and placed in service. Because of its increased carrying capacity as compared with the old wooden cars, the distribution of fish is greatly facilitated.

A large and inviting field for effective conservation work is the rescue of fishes from the overflowed lands in the Mississippi Basin.



Enormous losses to the food supply can be prevented by salvaging operations. The following figures cover rescue operations conducted between Homer, Minn., and Friar Point, Miss. The extent of this work, in summarized form, is as follows:

Catfish.....	4, 228, 800	Black bass.....	333, 720
Carp.....	706, 030	Sunfish.....	2, 398, 540
Buffalofish.....	206, 905	Pike perch.....	15, 780
River herring.....	177, 000	White bass.....	15, 300
Pike and pickerel.....	103, 610	Yellow perch.....	110, 105
Fresh-water drum.....	29, 805		
Crappie.....	1, 557, 010	Total.....	9, 885, 005
Warmouth bass.....	2, 400		

The cost of the rescue operations in 1917, including the salaries of the regular employees, was about \$15,000. The value of the rescued fishes, if purchased from commercial fish-culturists, would be about \$175,000. Basing an estimate on results obtained at fish-cultural stations and assuming that 60 per cent of the foregoing rescued fish would survive the natural mortality and reach a marketable size, it appears that the value of these fishes at the present market prices paid to the fishermen would be approximately \$500,000.

The Bureau's operations cover about 40 per cent of the available fields. The States of Wisconsin, Iowa, and Illinois conduct similar operations on a smaller scale, and some years they do not rescue any fish for lack of funds. The Bureau's work could easily be extended so as to cover 75 per cent of the available fields without interfering with any State. The number of fish rescued could be increased 300 or 400 per cent, at an increase in cost not to exceed 100 per cent.

The patrol of the Alaskan coast for the enforcement of the laws and regulations pertaining to the fisheries was conducted as usual. The fisheries of the Territory in 1916 attained a greater importance than ever before. The persons directly connected with the industry numbered 23,994; the capital invested was \$39,569,612; and the value of the products was \$26,156,559, of which \$24,054,838 represented salmon. The pack of canned salmon, amounting to 4,900,627 cases, was the largest ever made.

I have in my office a fine specimen of female humpback salmon taken from Dennys River, Me., in October, 1917. This fish has grown from an egg brought from the Pacific coast in 1915 and has attained a length of 22 inches and a weight of 6½ pounds. At the time of capture it was fully matured and ready for spawning. A large number of these fish have returned to the Maine rivers in which they were planted and the experiment of transferring this

type of Pacific salmon to the eastern coast must therefore be reckoned as entirely successful. In the Dennys River alone, at least 2,000 adult fish were observed in 1917.

The Alaskan halibut fishery, which ranks next to the salmon in importance, has been the subject of a controversy involving the action and attitude of the Canadian Government toward Alaskan vessels that have been induced to make Prince Rupert, British Columbia, a port of discharge. As this report is prepared a conference between representatives of the Canadian Government and our own has been arranged with a view to reaching a joint agreement relating to the entire fisheries question as it affects the two countries which, it is hoped, may become the basis of joint official action by both nations. The Assistant Secretary of Commerce, Hon. Edwin F. Sweet, and the Commissioner of Fisheries, Dr. Hugh M. Smith, have been appointed to represent this Government at the conference, and word has come from the British and Canadian authorities that these appointments are acceptable to them.

It has not been found necessary to close any additional waters to commercial fishing in order to maintain the supply of salmon in given sections. The advisability of limiting the fishing operations in the Situk River was considered at a public hearing held in Seattle in December, 1916, but the facts developed at this hearing did not warrant any affirmative action at this time, although a further investigation which has been undertaken may necessitate restrictions.

The force of wardens in the Alaska service was actively engaged throughout the year in enforcing the laws pertaining to the minor fur-bearing animals. Statistics collated by the Bureau indicate that the value of the furs shipped from Alaska in 1916 was upward of \$900,000, exclusive of the Government's fur-seal and fox skins taken on the Pribilof Islands.

#### **Closing of Fish Hatcheries.**

The acts making appropriations for the Bureau of Fisheries have for many years contained the following stipulation and mandatory provision with reference to the sums made available for the propagation of food fishes:

No part of the appropriations herein for propagation of food fishes shall be expended for hatching or planting fish or eggs in any State in which, in the judgment of the Secretary of Commerce, there are not adequate laws for the protection of the fishes, nor in any State in which the United States Commissioner of Fisheries and his duly authorized agents are not accorded full and free right to conduct fish-cultural operations, and all fishing and other operations necessary therefor, in such manner and at such times as is considered necessary and proper by the said commissioner or his agents.

The Department, after very careful consideration of its obligations and after a protracted precautionary attitude, has been compelled, in observance of this law, to close two hatcheries—one located near Havre de Grace, Md., at the mouth of the Susquehanna River; the other at San Marcos, Tex. Regarding the former the following note appeared with my approval in the Fisheries Service Bulletin for February 1, 1917:

The Secretary has approved the recommendation of the Commissioner that the Battery Island shad hatchery, in the mouth of the Susquehanna River, near Havre de Grace, Md., be not operated during the present year and that no date be set for resuming operations. This action is necessitated by conditions fully set forth in a letter from the Commissioner to the Secretary dated January 27, from which the following extracts are taken:

"The possibility that the Bureau might be driven to this step has been appreciated by you for nearly four years. Each season in that period the condition of the fisheries at the mouth of the Susquehanna has been taken under consideration with reference to our fish-cultural work. In annual reports, in special reports to members of the legislature, in communications to the governor, in press notices to the fishermen and the general public, and in personal statements and appeals, we have shown the necessity for a radical change of policy on the part of the State of Maryland in order that the further depletion of once valuable fisheries might be arrested and the abundance of important food fishes might be restored and maintained. Nothing has been done to improve the situation. The State continues to permit practices known to be inimical to the best interests of the fisheries and directly antagonistic to the efforts of the Bureau of Fisheries in behalf of the people of the State. The future expenditure of effort and money under the circumstances is not only inadvisable and unjustified, but is clearly forbidden by the following stipulation which Congress has wisely placed on our annual appropriations for the propagation of food fishes:

"'No part of the appropriation herein for propagation of food fishes shall be expended for hatching or planting fish or eggs in any State in which, in the judgment of the Secretary of Commerce, there are not adequate laws for the protection of the fishes.'

"The Government has been conducting shad-cultural operations at Havre de Grace since 1877, and has occupied the present site since 1880. Owing to its favorable location and the cordial cooperation of the fishermen, the hatchery was able to save the spawn of a very large percentage of the ripe shad caught for market, and the output season after season tested the full capacity of the plant. In fact, this hatchery has a record of young shad produced that is not approached by any other; and the abundance of fish was assured year after year, notwithstanding an enormous catch. Gradually the methods of fishing have undergone a change and there has arisen a new generation of fishermen apparently indifferent to the needs of the shad, forgetful of their own interest, disinclined to cooperate with the Government, and insisting on the use of methods that are contrary to the interests of the State and of its people. The legislature, with the weight of evidence and testimony available regarding the obnoxious fishing methods, would be justified in summarily suppressing them as a nuisance; they remain unaltered. There is thereby placed on the Federal Government a task that yearly becomes more difficult, more expensive, and more unsatisfactory to all persons having the welfare of the fisheries and the fishermen at heart.

"In the earlier years cited, the average cost of collecting and hatching shad eggs at Havre de Grace was well under \$100 per million. In 1915 the cost exceeded \$1,940 per

million, and during the past three seasons has averaged \$1,216 per million, or more than twelve times the former cost.

"The entire history of the hatching operations on the Susquehanna shows that the Bureau has spared no effort and expense to aid the fisheries and maintain the supply of Maryland's most important food fish. I would favor the resumption of our operations as soon as the State gives evidence of a due appreciation of the Government's work by the enactment of laws placing proper restrictions on the fishing."

On May 23, 1917, the following order was, with my approval, issued by the Commissioner of Fisheries:

DISCONTINUANCE OF FISH CULTURE AND FISH PLANTING IN TEXAS.

Owing to the failure of the State of Texas to comply with the stipulations imposed by Congress with regard to the fish-cultural work of the United States Bureau of Fisheries, the Secretary of Commerce has been compelled by law to close the fish hatchery at San Marcos, Tex., and to discontinue the planting of fish in Texas. About 700 applications for fish which were to have been supplied this season will have to be suspended and no new applications can be listed until the State accepts the conditions which Congress has prescribed, namely, (1) that the fishes cultivated and distributed by the Bureau receive adequate protection, and (2) that the United States Commissioner of Fisheries and his duly authorized agents are accorded full and free right to conduct fish-cultural operations, and all fishing and other operations necessary therefor, in such manner and at such times as the Commissioner or his agents consider necessary and proper.

On September 26, 1917, the Texas Legislature, in extraordinary session, enacted a measure apparently thought to meet the conditions imposed by Congress in the law quoted on page 161. This act of the Texas Legislature (S. B. No. 6) was submitted by me to the Commissioner of Fisheries, who comments upon it thus:

This bill was not seen by any official of the Department of Commerce or the Bureau of Fisheries until after its passage. Neither the Department nor the Bureau was consulted by any State officials regarding any of the provisions of the measure. The bill differs radically from previous measures which have been designed to meet the obligations imposed by Congress on the State of Texas in order that appropriations for the propagation and distribution of food fishes may legally be expended in that State. Furthermore, the bill differs in its essential features from the measure which was advocated by the business men of San Marcos and presented to the legislature as their request.

This bill does not accord with any features of the mandatory provision of the act of Congress which it was ostensibly designed to meet. \* \* \*

The features of this bill in which the Bureau can not concur, because they do not comply with the law and serve to handicap rather than expedite its operations, are at follows:

(1) Section 1, paragraph 3: \* \* \* It shall also be lawful for the United States Commissioner of Fisheries and his duly authorized agents to take from public fresh waters of this State all brood fish necessary in the operation of Federal Fish Hatcheries, provided that no fish except brood fish shall be so taken for any purpose.

This paragraph imposes restrictions on the operations of the Bureau such as exist in no other State. While, by the express terms of the bill, any citizen of Texas may catch and kill any black bass that are more than 6 inches in length and any other fish without regard to size, the Bureau, although engaged entirely in work for the benefit of the fish supply of the State, is prohibited from taking any but "brood fish," and apparently they have to be taken outside of the close time imposed by section 3 of the bill. If the Bureau desires to make collections of young fish, say, for the purpose of introducing new stock in its ponds, it is prohibited from doing so. If the Bureau desires, in the interests of conservation, to salvage fishes that are perishing in Texas streams and lakes that are becoming dry, it is prohibited from doing so. If the Bureau desires to collect diseased fishes in the public waters of Texas in order to study them and suggest measures for combating the disease, it is prohibited from doing so unless these fish are taken during the open season and are to be considered as "brood fish." If the Bureau desires to transplant young or immature fish from one public water of Texas to another, as to the desirability of which the Bureau is the best judge, it is prohibited from making such transfer.

(2) Section 2 accords to the Bureau certain rights to fish hatching and fish culture but restricts the exercise of those rights to "the prescribed limits of the Federal Fish Hatcheries." It may be questioned whether the Texas Legislature has any jurisdiction whatever over such reservation so far as fish-cultural work is concerned, so this paragraph is meaningless except in so far as it shows the intention of the Texas Legislature to prevent the proper exercise of the functions of a fishery station. The clause "all operations connected therewith" when applied to fish hatching and fish culture obviously covers the sending of shipments of fish away from the hatchery and the planting of them in public and private waters.

(3) Sections 3 and 4 of the bill do not, in my opinion, afford to the fishes cultivated at the San Marcos station the protection which they should receive. The close time covering the spawning season of the crappie and bass is satisfactory but the size limit of bass is so small as to afford no protection worthy of the name. The absence of size limit on any other fishes, including crappie, rock bass, and sunfish, which are among the species regularly propagated at San Marcos, indicates the failure to appreciate the necessity of according to such class of fishes at least a minimum degree of protection.

Comment upon this incident should not close, however, without its being said that the business interests of the city of San Marcos, Tex., have actively striven to relieve the conditions which make impossible the operation of the fine hatchery located in their midst. The Representative in Congress from the district in which San Marcos is located, Hon. James P. Buchanan, has labored unselfishly and intelligently to bring about such conditions as will comply with the will of Congress and permit continuing the operations of the San Marcos hatchery.

#### **Vessels.**

The absurd condition prevails in the marine service of the Bureau of Fisheries of having three different systems of operation among eight vessels. The matter is fully described in Appendix

E of this report, which deals with the whole subject of officers and crews on vessels of the marine services. As this report is written the Department has been obliged to give up a winter trip to the Pribilof Islands for the steamer *Roosevelt* because funds are not sufficient to pay the cost of the trip. Yet it was with such winter trips in view that the *Roosevelt* was purchased, since she is specially designed to navigate under arctic conditions. The Department intended by such use of that vessel to break the long six months' winter isolation on the Pribilof Islands which has heretofore caused serious conditions on those islands for lack of supplies. Furthermore, the Department has been obliged to decline a request of the Department of the Interior that the vessel be used on a winter trip to the islands to carry some supplies to the Alaska Railway at Anchorage and to determine the feasibility of winter navigation to that point.

#### **Chief Needs of the Bureau of Fisheries.**

1. A substantial and reasonable increase in the technical staff.

The magnitude and scope of the Bureau's operations, more particularly in the past two or three years, have outgrown the personnel. In order adequately to carry out its enlarged functions and to meet the important national duties devolving on it, the Bureau needs to have created by Congress new statutory positions in all branches of the service, including an assistant commissioner in charge of Pacific coast operations, an assistant in charge of the Alaska service, field superintendents in charge of segregated fish-cultural work, and technical assistants for the promotion of fisheries and for imparting to fishermen practical instruction in the methods of preparing and preserving the catch. Provision for these new positions is made in the estimates of appropriations for 1919.

2. A power derrick lighter for the seal islands hereinbefore described.

3. Increase in the general appropriation for the propagation and distribution of food fishes.

To enable the Bureau to operate to their full capacity the existing plants, including several new hatcheries that are now completed or nearing completion; to extend the fish-cultural operations into productive fields through the establishment of

auxiliary or field stations; and to conduct more extensively the highly successful and important work of salvaging fishes from the overflowed lands of the entire Mississippi Valley there is required an appropriation of at least \$25,000 in excess of the amount available for the current year (\$375,000). This increase of less than 7 per cent can and will be used for making immediate additions to the supply of food fishes in waters throughout the country.

4. Increased laboratory facilities in the field.

There is now pressing need for laboratories for technical experiments, research, and demonstrations in aid of the fisheries, fish trade, and fish culture, analogous to agricultural experiment stations.

5. A new central building, with laboratories and a national aquarium.

This matter is fully set forth in another part of this report.

The Commissioner of Fisheries in an address before the American Fisheries Society called attention to the need for an institution, national in its scope, for the technical instruction of fisherfolk. He pointed out that 1 person in every 80 throughout the United States is directly dependent on the fishing industry and yet there was not in the entire country a single school, academy, college, or university where so much as the rudiments of an education in fishery technique may be obtained, either gratis or on the payment of fees. Agricultural schools are everywhere, and wisely so, but the need of training for the fishing population is overlooked by both State and Federal Governments and no private interest has yet come to the aid of a most deserving part of our population. In this respect we are behind France, Japan, and Great Britain, where professional schools have been established under private, semi-official or official auspices. In Japan, especially, which is the leading fishing nation in the world in respect to the number of persons engaged and the quantity and value of products taken, the technical or professional instruction of the fisherfolk is regarded as indispensable to the industrial prosperity.

As things now are, there is an enormous waste of aquatic resources and in some regions conditions have arisen which threaten the perpetuity of the fishing industry and the food supply of many people. In places, the majority of the fishermen are of foreign birth and through ignorance, which there is no organized

means of removing, they are not always in sympathy with conservation measures which benefit both themselves and the community. It is earnestly to be hoped that something may soon be done to relieve this situation and it is now suggested that the powers of the Federal Board for Vocational Education may be enlarged by appropriate legislation to permit their giving Federal encouragement to training in this important subject.

It is a pleasure to note that quite recently the University of Washington inaugurated a fishery school, and it is hoped that this example may be followed by other universities.



## BUREAU OF LIGHTHOUSES.

(GEORGE R. PUTNAM, *Commissioner*.)

The general organization of the Service remained unchanged during the fiscal year.

On June 30, 1917, there were 5,796 authorized positions in the Lighthouse Service. Of these, 122 were in the technical force, 149 in the clerical and office force, and 5,525 connected with depots, lighthouses, and vessels. Compared with the previous year, this is an increase of 5 in the total force.

### Personnel.

The following table gives the number of employees (all authorized positions, including some vacancies) of the Lighthouse Service at the end of the fiscal year and a comparison of the totals with those for the previous fiscal year:

EMPLOYEES IN THE LIGHTHOUSE SERVICE ON JUNE 30, 1917.

District.	Inspectors, engineering force, draftsmen, aids, appointed foremen, and mechanics.	Clerks, messengers, janitors, and office laborers.	Depot keepers and assistants, including laborers.	Light keepers and assistants.	Laborers in charge of lights (appropriation "Salaries, keepers of lighthouses").	Laborers in charge of post lights and buoys (appropriation "General expenses").	Custodians of reservations.	Officers and crews on tenders and light vessels.	Field force for construction and repair (registered).	Field force for construction and repair (unregistered).	Total.
Bureau.....	14	25									39
First.....	3	6	1	114	2			70	8	9	213
Second.....	4	7	2	78	11			216	2	6	306
Third.....	22	30	17	180	32	56	2	279	178	44	840
Fourth.....	5	5	3	54	6	5	6	29	5	4	122
Fifth.....	11	9	34	173	93	20	1	257	6	6	610
Sixth.....	5	7	2	55	9	26		128	3	18	253
Seventh.....	2	3	1	41	1	7		31	4	14	104
Eighth.....	7	9	16	109	29	34		115	9	41	369
Ninth.....	2	5	1	34	5			24	16	6	93
Tenth.....	8	5	2	65	1		1	33	5	13	133
Eleventh.....	8	6	6	158	10	2	2	110	16	6	324
Twelfth.....	7	6	5	154	18	2	1	93	6	5	297
Thirteenth.....	1	2				323		17			343
Fourteenth.....	1	2				539					542
Fifteenth.....	1	2				372		20			395
Sixteenth.....	5	5	1	32		18		45	1	8	115
Seventeenth.....	6	6	4	79	15	117		121	5	2	355
Eighteenth.....	6	6	7	111	8	5		91	6	13	253
Nineteenth.....	4	3	1	27	2			25	3	5	70
Total, 1917....	122	149	103	1,464	242	1,526	13	1,704	273	200	5,796
Total, 1916....	123	147	69	1,473	241	1,524	12	1,592	270	340	5,791
Increase.....		2	34		1	2	1	112	3		5
Decrease.....	1			9						140	

### Aids to Navigation.

During the fiscal year ended June 30, 1917, there was a net increase of 275 in the total number of aids to navigation maintained by the Lighthouse Service. There was an increase of 5 fog signals, 33 lighted buoys, 189 unlighted buoys, and 62 minor lights (including 12 float lights).

Fixed lights were changed to flashing or occulting at 39 stations. The illuminant of 17 lights (including 1 light vessel) was changed to incandescent oil vapor, the illuminant of 26 lights (including 4 light vessels) was changed to acetylene, the illuminant of 13 lights was changed to electric incandescent, and the illuminant of 1 light was changed to oil gas.

On June 30, 1917, there were maintained by the Lighthouse Service, 15,223 aids to navigation, including 5,420 lights of all classes, and 588 fog signals (not including whistle and bell buoys), of which 51 are submarine signals.

The following are some of the more important aids which have been established or materially improved during the past fiscal year:

A new third-order light station with a flashing white oil vapor light and a first-class air siren was placed in commission at Cape St. Elias, Kayak Island, Alaska.

A new light vessel, *No. 101*, was established off Cape Charles, Va., in place of the old vessel *No. 49*, and new light vessel *No. 102* took the place of old *No. 43* at Southwest Pass Entrance to the Mississippi River, La.

The illuminating apparatus on Brunswick Light Vessel No. 84, Ga., was improved by changing from 2 fixed white to 1 flashing white light, and a similar change was made on Handkerchief Light Vessel No. 3, Nantucket Sound, Mass.

Fog signals were established at Eagle River Shoals, Lake Superior, Mich. (electric siren); Manistique, Mich. (air diaphone); Sheboygan Breakwater, Lake Michigan, Wis. (first-class air siren); and Cleveland West Pierhead, Ohio (air diaphone). Four air diaphones were installed on the Pacific coast in place of sirens or whistles, at the following stations: Scotch Cap, Unimak Pass, Alaska; Cape Flattery, Tatoosh Island, Wash.; Farallon and Point Conception, Cal.

Important lighted buoys were established at The Graves, Boston Harbor, Mass. (whistle); Popasquash Point, Narragansett Bay, R. I. (bell); Conaskonk Point Shoal, Raritan Bay, N. J., Bulkhead Shoal Channel, Delaware River, Del. (3 buoys); Sewall

Point Shoal, Hampton Roads, Va. (bell); Caucus Cut Entrance, Pensacola Bay, Fla. (whistle); Mobile Bay Entrance, Ala. (4 buoys, 1 with whistle); Brazos River entrance, Tex. (2 buoys, 1 with bell); Manchas Grandes, Mayaguez Harbor, P. R.; Gravelly Island Shoal, Lake Michigan, Mich. (bell); Outer Shoal, Lake Michigan, Wis. (bell); Orca Inlet (2 buoys) and Reef Island Reef, Prince William Sound; Poundstone Rock, Favorite Channel, (bell), and Channel Rock, Sitka Sound, Alaska; Duwamish Head, Seattle Harbor, Wash. (bell); and Grays Harbor Outside Bar, Wash. (whistle).

Systems of minor aids and buoyage were extensively rearranged or improved in the following important localities: Sand Shoal and Smith Island Inlets and Magothy Bay, Va.; Caximbas Pass, Fla.; Mobile Bay, Ala.; Houston Channel, Tex.; Tonowek Bay, Karheen Passage, and Zimovia Strait, Alaska; and San Diego Bay, Cal.

Flashing acetylene lights were established at Hunts Point, East River, N. Y.; Delaware City, Del.; Rancocas River Range, N. J. (2 lights); Fishing Point, Assateague Anchorage, Va.; Lower Cedar Point Beacon, Port Tobacco River Flats, and Persimmon Point Shoal, Potomac River, Md.; Tunnel Island Spit, Va.; Bull Spit, Fenwick Island Cut, Marsh Island Spit, and Steamboat Creek, S. C.; Two Harbors West Breakwater, Lake Superior, Minn.; Tonawanda Channel Range, Niagara River, N. Y. (2 lights); Fighting Island, Detroit River, and Portage Lake Pierhead, Mich.; San Diego Bay, Cal.; Cape Edwards Entrance, Hanin Rocks, Kodiak Harbor, Alaska; Kukii Point, Kauai Island, and Kipahulu, Maui, Hawaii.

The beginning of lighthouse work in America was commemorated in Boston, Mass., on September 25, 1916, when a bronze tablet was unveiled at Boston Light Station, on the two-hundredth anniversary of its establishment. The Department was represented on the occasion by officers of the Lighthouse Service and myself. A number of Federal, State, and municipal officers, as well as representatives of commercial, maritime, and historical organizations of Boston, were also present. A full account of this celebration was published as a special bulletin of the Lighthouse Service.

The Gulf coast suffered from three tropical hurricanes during the fiscal year. These storms occurred on July 5, 1916, in the general vicinity of Mobile, Ala., on August 18, 1916, near Aransas Pass, Tex., and on October 18, 1916, around Pensacola Bay, Fla. The July storm was by far the most severe of these, and damaged property of the Lighthouse Service to the extent of about \$140,000.

Congress, by the act of September 8, 1916, appropriated \$125,000 to repair this damage. The aggregate damage of the August and October storms was about \$60,000. (The urgent deficiency act of October 6, 1917, appropriated \$20,000 to repair hurricane damage at Aransas Pass.) No lives of persons in the Lighthouse Service were lost in any of these storms.

Ice conditions during February, 1917, were unusually severe in the North Atlantic coast districts, and many aids to navigation, as well as lighthouse vessels, were damaged, particularly in Buzzards Bay, Mass.; New York Bay, N. Y. and N. J.; Delaware Bay, N. J. and Del.; and Chesapeake Bay and tributary waters, Md. and Va.

For the general assistance of persons navigating in motor boats and other small craft, the Department issued a card with illustrations showing various types of buoys and brief rules regarding their colors and numbers, along with the distances of visibility for objects of stated elevations above sea level.

In my report for the fiscal year 1916 I referred at page 156 to the general inquiry made by the Interdepartmental Board on Coastal Communications respecting means of communication by telegraph and telephone between light stations and other Government coast stations and the general communication system of the country. This board, authorized at my suggestion by the President's order of February 16, 1916, gave careful consideration to this important subject, and as a result of its report, and the urgent recommendations made by the Secretary of the Treasury, the Secretary of the Navy, and myself, Congress appropriated \$300,000 by the act of June 12, 1917, to enable the United States Coast Guard to extend its telephone system to include all Coast Guard stations not now connected, and to include the most important light stations which have at present no means of rapid communication. Work under this appropriation is progressing.

#### **Alaska.**

The total number of aids to navigation in Alaska, including lights, gas buoys, fog signals, buoys, and daymarks, in commission at the close of the fiscal year ended June 30, 1917, was 416, including 152 lights and 7 gas buoys, representing an increase of 122 lighted aids since June 30, 1910, or 330 per cent. The table following, which gives the total number of aids to navigation on June 30 of each year named, illustrates the progress in establishing aids in the Territory.

Aids.	1910	1911	1912	1913	1914	1915	1916	1917
Lights.....	37	71	85	93	108	112	147	152
Gas buoys.....								7
Fog signals.....	9	10	10	10	10	10	11	11
Submarine bell.....								1
Buoys.....	84	105	132	136	157	167	181	189
Daymarks.....	30	29	38	40	44	49	49	56
Total.....	160	215	265	279	319	338	388	416

The light and fog signal station at Cape St. Elias, for which an appropriation of \$115,000 was made by the act of October 22, 1913, was completed during the year and lighted for the first time on September 6, 1916. Within a few weeks after its establishment, a master of a passing merchant vessel reported that reflections of the light were visible at a distance of 37 nautical miles, on a cloudy night with heavy rain squalls and a rough sea.

The appropriation of \$60,000 made by the act of August 1, 1914, for aids to navigation in Alaska, has been expended in providing needed improvements at about 40 places. A further appropriation of \$60,000 was made for the same purpose, by the act of June 12, 1917. Work on this project was started at once, and good progress has been made up to the date of this report.

The new lighthouse tender *Cedar*, for which \$250,000 was appropriated by the act of January 25, 1915, was completed during the fiscal year, except for a few minor items, and sailed from Long Beach, Cal., on July 11, 1917, for assignment to Alaskan duty. The tenders *Kukui* and *Fern* have been assigned to the Alaska district during the year.

### Virgin Islands.

The lighthouse work in the islands of St. Thomas, St. Croix, and St. John, with the outlying rocks and islets, formerly constituting the Danish West Indies, and now the Virgin Islands of the United States, was by Executive order of the President, dated July 20, 1917, placed under the Lighthouse Service, following the customary procedure in such cases.

### Administrative Methods and Economies.

A fourth annual conference of lighthouse inspectors, authorized by me, was held during January, 1917. The program followed the previous general lines and the results are believed beneficial to the Service.

A compilation of data relating to hours of fog and its relative prevalence at different seasons of the year was made from information on file, based on the regular records at fog-signal stations. Records of fog have been kept in a systematic manner since 1885 and are now sufficiently complete to provide material for study of this matter from both meteorological and engineering standpoints.

Careful attention was given during the fiscal year both by the Department and the Bureau to conditions affecting pay and subsistence, particularly on board vessels. In order to bring about as uniform conditions as the widely different character of the work of the several maritime bureaus and service might permit, the Department authorized a Marine Board, on which the Lighthouse Service is represented, to consider such problems. A more detailed statement in reference to this question appears in Appendix E.

The Department authorized a new regulation covering the leave of absence on light vessels and stations, in order to make conditions surrounding leave of employees as liberal as the interests of the Service will permit and to secure and retain a competent class of men on light vessels and at isolated light stations.

An increase in the allowance for shore liberty of officers and crews of light vessels was recently approved by the Department, by which these employees may be granted not to exceed 120 days shore liberty per year in the case of isolated light vessels without convenient communication with shore and 108 days per year for vessels not distant from shore and having convenient communication. This is in lieu of the former allowance of 90 days per year, with 1 day for time of transit each way for men on isolated vessels. The Department has also approved the granting of not to exceed 96 days leave per year for keepers at isolated light stations, instead of 72 days formerly allowed, or at the average rate of 8 days per month for coast districts and lake stations in operation throughout the year.

The Lighthouse Service took part with other bureaus of the Department at the Southern Commercial Congress held in Norfolk, Va., during December, 1916; and a small exhibit illustrating various types of structures and apparatus was shown at the annual meeting of the Chamber of Commerce of the United States held in Washington, D. C., during January, 1917. The Service was also awarded a gold medal in recognition of its exhibit at the Panama-California International Exposition held at San Diego, Cal., during 1916.

With a view to saving the frequent expense of obtaining telegraphic authority, the Department authorized, with the understanding that the circumstances must be promptly reported by mail, a regulation permitting inspectors to assign suitable persons to duty under civil-service rules in case of vacancies occurring by reason of death, sickness, or other circumstances where immediate filling of a position is necessary for the proper safeguarding of life and property.

In order to reduce paper work entailed by reports of officers detailed from one vessel to another for short periods of duty, the Department authorized inspectors to make such details for one month or less without the necessity of obtaining prior authority or reporting the case specially.

Following my suggestion, all persons on lighthouse reservations were urged to cultivate as much land as possible for growing foods.

I also suggested a canvass be made throughout the Service relative to subscriptions to the first Liberty Loan Bonds authorized during the year, with the result that 1,066 persons in the Service purchased these bonds to the total amount of \$230,750.

Systematic inspections of the various lighthouse districts by the general inspector, examiner, and officers of the Bureau were continued as in former years with satisfactory results.

The standard method of cost keeping was continued as usual.

The Department gave attention during the year to various suggestions offered in the way of saving of paper and other office supplies, such as the use of half-sheet letterheads, lighter grades of paper, single spacing of typewritten letters, use of spare paper for scratch pads, etc., and as a result of these, issued supplemental instructions which have resulted in substantial economies.

The Bureau also introduced a number of economies in printing, with the assistance of the Division of Publications, so that the expense of printing for the Service during the fiscal year was reduced to 85 per cent of the allotment made for the purpose by the Department.

#### **Engineering and Construction.**

New works of principal importance under special appropriations completed during the fiscal year are as follows: New carpenter shop at the general depot, Tompkinsville, N. Y.; Charleston depot, Charleston, S. C.; Manistique lights and fog signal, Mich.; and Cape St. Elias light and fog signal, Alaska.

Other important work in progress at the close of the fiscal year includes Dog Island Light, Me.; Woods Hole depot improvements, Mass.; aids to navigation, Hudson River, N. Y.; aids to navigation, Delaware River, Pa. and Del.; aids to navigation, St. Johns River, Fla.; additional lights, Florida Reefs, Fla.; lighting Mississippi River below New Orleans, La.; repair of hurricane damage, Gulf of Mexico; Navassa Island Light Station, West Indies, and aids to navigation at Ashtabula, Cleveland, and Lorain, Ohio.

The most important item of construction work completed during the year was the new Cape St. Elias Light Station, Alaska, to which reference has previously been made. This light is of 300,000 candlepower and forms the landfall for vessels bound to Prince William Sound or Cook Inlet from either the Pacific coast of the United States or southeastern Alaska.

Much repairing of hurricane damage was done in the Gulf of Mexico districts. All care possible, within the limits of available funds, was taken to give the new structures increased strength and rigidity, in order to avoid as far as practicable such destructive effects in the future.

A standard form of map and instructions for surveys of lighthouse reservations was prepared and issued during the year, to insure future uniformity in such work.

#### **Improvement of Apparatus and Equipment.**

Floating beacons, designed for emergency use in replacing minor lights in inside waters carried away by ice or damaged by collision, pending the reconstruction of the permanent light, have been built and tested in service with satisfactory results.

Experiments have been conducted at the general depot with a view to the manufacture of 375-millimeter (about 15-inch) pressed-glass buoy lenses for use in place of the present expensive cut-glass lenses. Practical tests by actual visual observation and by the photometer indicate that almost equal efficiency can be obtained by the use of pressed-glass lenses, at a cost of about 40 per cent of the former cut-glass lenses, and, as a result, pressed-glass lenses have been adopted for future use in all 375-millimeter lanterns.

A committee composed of representatives of the Navy Department and Department of Commerce, including the Lighthouse Service, has been appointed to consider and report on the further use of radio apparatus for fog-signal purposes and to coordinate experimental work along the lines now in progress, and various tests are being made.



Kerosene for fuel was in use in the galley range aboard several vessels with good results and has been found more satisfactory than coal. The system installed consisted of a standard type outfit as used for oil-vapor lamps, with a starting torch and the necessary accessories, including also specially arranged fire brick.

A new type of post lantern with an automatically occulting light, designed in the Bureau, is now being tested and gives promise of furnishing an improvement.

The continued use of oil engines in place of steam for power and for operating fog signals has demonstrated the greater economy and convenience of such apparatus and the use of these engines is being extended as boilers now in service become unfit for further use.

A thermostat designed to warn keepers by ringing a bell when undue fluctuations occur in operating oil-vapor lamps, has been developed and issued to a number of stations, where it has been found that such thermostats are of benefit to the proper maintenance of the lights.

A new type of gas and whistling buoy, of practically the same size as the Type L now in use, but with the addition of a whistle, has been designed at the general depot. It is believed this will give a buoy of suitable size for channel work and other locations where a larger type would be too heavy.

The work of standardization has been extended during the past year as heretofore, and in many cases articles and parts have been completely standardized and are now interchangeable, so that repair parts may be kept on hand for issue at short notice. Work has also been started on small drawings of such parts, on letter-size sheets so arranged as to bind in book form for distribution to the district offices, facilitating identification and reference.

### **Appropriations.**

In addition to the maintenance appropriations for the current fiscal year, appropriations for the following special works were made by Congress:

Repairing and rebuilding aids to navigation, Gulf of Mexico .....	\$125,000.00
For adjustment of claims for damages for which vessels of the Lighthouse Service were found responsible .....	56.88
Lighthouse tender, third district or general service .....	150,000.00
Cape Charles, Va., light vessel .....	130,000.00
Aids to navigation, Pearl Harbor, Hawaii .....	80,000.00
Improving office and laboratory at the general depot, Tompkinsville, N. Y. ....	21,000.00
Aids to navigation, Huron Harbor, Ohio .....	4,500.00
Light station, Point Borinquen, P. R. ....	85,000.00

Rebuilding Chicago Harbor Light Station, Ill.....	\$88,000.00
Aids to navigation, Fairport, Ohio.....	42,000.00
Light vessels for the Great Lakes.....	150,000.00
Light and fog signal, Sand Hills, Lake Superior, Mich.....	70,000.00
Improving light and fog signal, Manitowoc North Breakwater, Wis.....	21,000.00
Improving aids, East River, N. Y.....	16,000.00
Aids to navigation, Keweenaw waterway, Portage River, Mich.....	105,000.00
Improving aids, Cape Charles City, Va.....	12,800.00
Improving aids, eastern shore Chesapeake Bay, Md. and Va.....	29,000.00
Aids to navigation, Alaska.....	60,000.00
Aids to navigation, Indiana Harbor, Ind.....	100,000.00
Improvements, Great Salt Pond Light Station, P. R.....	20,000.00
Radio equipment, lighthouse tenders.....	60,000.00
Aids to navigation, Washington and Oregon.....	35,000.00
Aransas Pass Light Station, Tex.....	20,000.00

Particular attention is again invited to the urgent need of the Lighthouse Service for additional funds. The cost of all materials has greatly increased, salaries and wages have been uniformly advanced, and in order that the Service may be maintained at a proper standard of efficiency, a corresponding increase in its appropriations is necessary. The Department desires to lay especial stress on this matter, and under a separate heading, includes a more detailed statement with reference to pay on vessels. (See Appendix E.)

The estimate for the Bureau of Lighthouses in Washington is the same as the appropriation for the preceding year. Estimates for 20 special works have been submitted, aggregating \$1,931,000, considering only group I, of which items amounting to \$317,000 are authorized by law. This is \$631,700 more than the appropriations for special works for the preceding year and includes a number of important works for which estimates were submitted last year but which were not included in the appropriations. The estimates include three new lighthouse tenders, one new light vessel, two new lighthouse depots, four items for establishing or improving aids in general localities, three items for a new system of harbor or channel lights and other aids, two items for improvements of light or fog-signal stations, four items for improvement of lighthouse depots, and one item for light-keepers' dwellings.

In selecting and submitting estimates for those special works believed to be most important, there were considered estimates submitted by officers in the various districts and others for new lighthouse and ship construction aggregating about \$5,600,000.

#### **Lighthouse Tenders.**

The tenders of the Service have been employed to good advantage during the year. The 50 vessels which have been in commis-

sion have steamed a total of about 464,000 nautical miles in their work of supplying light stations, maintaining the buoyage system, transporting construction materials, and carrying the officers and employees of the Service to their stations or on inspection duty.

Contract was awarded May 4, 1915, for the construction of the first-class seagoing lighthouse tender *Cedar*, for service in Alaska. The vessel was launched December 27, 1916, the official trials were satisfactorily completed June 12 and 13, 1917, the vessel was conditionally accepted June 30, 1917, and proceeded from Long Beach, Cal., to station at Ketchikan, Alaska, on July 11, 1917. Stops were made at San Francisco and Seattle for minor fitments and receiving cargo for lighthouse work and other Government services, and the vessel arrived at Ketchikan, August 18, 1917.

A contract was awarded for the shallow-draft tender *Palmetto*, on September 27, 1915, for service in the inland waterways of the sixth lighthouse district. The vessel was launched June 30, 1916, and completed March 19, 1917, being immediately assigned to duty in the district.

An appropriation of \$20,000 was made by the act of July 1, 1916, for a light-draft tender and barge for use in establishing and maintaining aids along the intercoastal waterways of Texas and Louisiana. Proposals have been twice advertised for this equipment without result; it has therefore been necessary to defer action until conditions become more favorable.

With the increase in the number of aids to navigation and the deterioration of older vessels, it will be necessary to construct on an average one or two new tenders each year.

The act of June 12, 1917, appropriated \$150,000 to replace the tender *Gardenia*, which has been surveyed, recommended to be condemned and sold, and is laid up as being of no further use. The same act appropriated \$60,000 for furnishing seagoing tenders with radio equipment. Work on these objects is now progressing.

Estimates have been submitted for three new lighthouse tenders to replace the present tenders *John Rogers*, *Jessamine*, and *Holly*, or for general service, as may be found most desirable, at a cost of \$200,000 each. The vessels mentioned are all old, unseaworthy, sidewheel steamers, which should be laid up as soon as arrangements can be made.

The acquisition of the tender *Dandelion*, which went into commission April 7, 1917, for use on the upper Mississippi River, with the publication of soundings, channel reports, and other bulletins of interest to rivermen, has effected a decided improve-

ment and has proven satisfactory to commercial lines operating on the river.

Copies of the Department's pamphlet entitled "Advisory Conference on the Subject of Making Passenger Vessels More Secure from Destruction by Fire" were distributed to the district offices and to each vessel in the Service.

#### **Light Vessels.**

The Lighthouse Service maintains light vessels on 53 stations and has for this purpose 68 light vessels, of which 15 are relief vessels. Some of these vessels are old, 13 having been built over 50 years ago—one is 68 years old—and are in a condition which does not warrant extensive repairs.

Contracts were awarded for the construction of second-class light vessels *No. 101* and *No. 102* on March 6, 1915. *No. 102* was launched November 27, 1915, accepted on January 3, 1917, and was placed on station at Southwest Pass Entrance to Mississippi River, La., on February 24, 1917. *No. 101* was launched January 12, 1916, accepted September 27, 1916, and on October 4, 1916, was placed on station off Cape Charles, Va.

Plans and specifications have been completed and bids invited for the construction of the new third-class light vessel *No. 99*, and a contract for construction was awarded June 29, 1916. Favorable progress was made by the builders up to July 10, 1917, when a fire of unknown origin destroyed the building ways and adjacent buildings at the shipyard, damaging the vessel beyond repair. The matter of rebuilding was at once taken up with the contractors, but the approximate time of completion can not be determined at present.

The balance of the appropriation remaining for light vessel *No. 100* is insufficient for the construction of the vessel due to the high cost of materials, and consideration of the matter has therefore been deferred for the present.

The act of June 12, 1917, appropriated \$130,000 for a light vessel off Cape Charles, or for general service, and \$150,000 for light vessels on the Great Lakes, where they are much needed to replace old vessels which should be withdrawn from duty. Work on the plans for these vessels was progressing at the close of the year.

An estimate is submitted for a new light vessel for the Gulf coast, or for general service, which is greatly needed.

The work of reconstructing light vessel *No. 82*, referred to in previous annual reports, was completed in time for the vessel to go on station as a relief vessel for the Great Lakes during the fall of 1916, and she has been since engaged in that work.

#### **Salaries and Wages on Lighthouse Vessels.**

The subject of salaries and wages on lighthouse vessels is discussed in detail in Appendix E of this report.

#### **Cooperation.**

In accordance with the established custom of the Service, every effort has been made to consult the needs of maritime interests and to cooperate effectively with other branches of the Government in matters relating to the work of the Lighthouse Service.

During the past year, the most important work of this character was the cooperation of the Lighthouse Service with the military branches of the Government. The naval appropriation act of August 29, 1916, authorized the President, whenever in his judgment a sufficient national emergency exists, to transfer to the service and jurisdiction of the Navy Department, or of the War Department, such vessels, equipment, stations, and personnel of the Lighthouse Service as he may deem to the best interest of the country; and also provided that the Secretary of the Navy, the Secretary of War, and the Secretary of Commerce shall jointly prescribe regulations governing this condition. These regulations were issued April 11, 1917, and on the same date, the President signed an Executive order transferring 30 lighthouse tenders to the War Department, and 15 lighthouse tenders, 4 light vessels and 21 light stations to the Navy Department. By July 1, 1917, all tenders transferred to the War Department had been turned over to the Navy where they are at present in service.

At the general lighthouse depot at Tompkinsville, N. Y., in addition to the work done by the tenders directly under the orders of military officers, facilities have been afforded for the berthing of naval vessels; offices and quarters have been provided for naval detachments; repairs have been made to naval patrol boats; and buoys, moorings, and other special equipment have been purchased for, or loaned to, the military authorities.

Cooperation was also rendered the Bureau of Fisheries in inspection and supervision of repairs to vessels belonging to that service under direction of its representatives. Arrangements were also made at the request of the Bureau of Fisheries for catching sharks

from light vessels on the South Atlantic and Gulf coasts, the skins to be used in experimental tanning work conducted by that Bureau.

Arrangements were also made with the Weather Bureau, Department of Agriculture, to furnish that service certain meteorological observations made on selected light vessels and light stations. In the case of light vessels equipped with radio, these observing stations are particularly valuable, not only in obtaining forecast data for use of the Weather Bureau, but also in distributing such forecasts to incoming and outgoing merchant ships.

The Forest Service, Department of Agriculture, continued to render valuable assistance to the Lighthouse Service in the matter of examinations and reports relating to timber on various lighthouse reservations, under authority of the act of March 3, 1915.

Measures were taken to furnish the Coast and Geodetic Survey with copies of monthly records showing the hours of operation of various important fog-signal stations. Further assistance was rendered the Survey by the placing of special buoys for use in offshore surveying operations, and by the detail of a technical employee on the trial board of a new steamer for that service.

The Navy Department, by letter of January 25, 1917, authorized the commandants of a number of navy yards and stations to issue, upon request of commanding officers of vessels of the Lighthouse Service, such articles of provisions as might be spared without detriment to the naval service, payment to be made by transfer of funds to the proper appropriations.

Arrangements were made with the office of the Chief of Engineers, War Department, relative to the display of lights and signals by persons or corporations obtaining permits from that Department for building structures or work in navigable waters; and also on the subject of charges made by the Lighthouse Service for expenses incurred in the marking of wrecks or other menaces to navigation.

The Public Health Service rendered valuable assistance to the Lighthouse Service in the matter of sanitary advice, inspections, and fumigations at various stations and vessels of the Lighthouse Service, and also in the preparation of regulations governing the physical examination of keepers provided for in the act of August 28, 1916, which authorized free medical relief to that class of employees

The Bureau of Mines continued to assist the Lighthouse Service in making analyses of coal, purchased on contracts providing for such analyses.

**Legislation Enacted Affecting the Lighthouse Service.**

The following is a summary of special legislation affecting the Lighthouse Service other than appropriations enacted during the fiscal year, 1917.

The act of August 28, 1916, granted authority for the following purposes:

Exchange of rights of way of the United States in connection with lands pertaining to the Lighthouse Service for such other rights of way as may be advantageous to the Service, providing also for the payment of any expenses, not exceeding \$500, incurred by the United States in making such exchange, from the appropriation "General expenses, Lighthouse Service."

The establishment and maintenance, in the discretion of the Commissioner of Lighthouses, of post-lantern light and other aids to navigation on the Mobile, Tombigbee, Warrior, and Black Warrior Rivers, Ala., and Lake Tahoe, Cal. and Nev.

The purchase, necessary equipment, repair, and operation of one motorcycle for the use of the Lighthouse Service in the Hawaiian Islands.

Medical relief for light keepers and assistant light keepers without charge at hospitals and stations of the Public Health Service, and providing also for certain physical examinations of persons who enter the Service hereafter.

The following works were authorized by the same act, at the limits of cost specified, but no appropriation of funds was made: Light-keepers' dwellings, \$75,000; lighthouse depot for second district, \$85,000; improvements at Detroit depot, Mich., \$53,000; temporary depot at Honolulu, Hawaii, \$5,000; and lighthouse depot for nineteenth district, \$90,000. A number of other projects authorized in this act were appropriated for in the act of June 12, 1917, as mentioned in the list on pages 176 and 177.

The naval appropriation act of August 29, 1916, authorized the transfer of portions of the Lighthouse Service to the War and Navy Departments under conditions as previously explained on page 180 and provided that the expenses of such transferred portions should be defrayed out of the appropriations of the department to which the transfer was made. This provision was subsequently amended by the naval deficiency act of June 15, 1917,

which provided that naval appropriations shall be available for expenses of the Lighthouse Service while cooperating with the Navy in so far as the regular appropriations for the Lighthouse Service are insufficient.

The employees' compensation act of September 7, 1916, provides, among other matters concerning payments to employees of the United States suffering injuries while in the performance of their duties, that such payments shall be made from the employees' compensation fund, instead of from salary appropriations of the Lighthouse Service as heretofore.

The act of February 14, 1917, referred the case of the British steamship *Esparta*, which on October 26, 1905, was in collision with the lighthouse tender *Magnolia*, in the Mississippi River below New Orleans, to the United States District Court for the Eastern District of Louisiana with jurisdiction and authority to determine the liability of the United States.

The act of March 2, 1917, providing a civil government for Porto Rico, stipulated in section 6 thereof, that the status of lighthouse work shall remain under Federal control as at present.

The legislative act of March 3, 1917, and the sundry civil act of June 12, 1917, provided for the Bureau and the field force of the Lighthouse Service, respectively, identical legislation for increased compensation, during the fiscal year, 1918, at the rate of 10 per cent per annum to employees receiving less than \$1,200 per annum, and at the rate of 5 per cent per annum to employees receiving not more than \$1,800 per annum and not less than \$1,200 per annum.

The act of June 12, 1917, also provided that the limit of cost of construction of outbuildings at any one light station in any one fiscal year may be increased from \$200 to \$500, as recommended by the Department.

#### **Special Legislation Needed.**

The following additional legislation for the Lighthouse Service is considered desirable:

The salaries of lighthouse inspectors are, by the act of June 17, 1910, limited to \$2,400 a year, except the inspector of the third district, whose salary is fixed at \$3,600. The salary of \$2,400 is inadequate because of the heavy responsibilities with which the inspector is charged and the technical and business ability required to successfully discharge the duties. This subject is treated in Appendix C to this report.



It is recommended that authority be granted to make the appropriation "General expenses, Lighthouse Service," available for the payment of traveling expenses and subsistence of teachers employed by State or private persons to instruct the children of keepers of lighthouses. The Department has endeavored to develop plans for the proper education of keepers' children at stations not accessible to schools, and in some States has been able to obtain the cooperation of the State educational authorities. It is believed that Government assistance in the matter of providing subsistence for such teachers while at stations would assist in promoting a worthy object at comparatively trifling expense.

It is recommended that the rate of commutation of rations to keepers and assistant keepers of the Lighthouse Service, fixed by the act of May 14, 1908, at 30 cents per day, be increased to 45 cents per day. Such an increase was authorized the United States Coast Guard by the act of June 12, 1917, and the extraordinary advance in the cost of foodstuffs, it is believed, makes a similar action in the Lighthouse Service fully justified.

The act of March 2, 1867, fixed the salaries of lighthouse keepers at not to exceed an average of \$600 per annum to each keeper. This rate has remained unchanged for over 50 years, and under present conditions it is practically impossible to attract and retain competent persons for this class of work at a salary so low; and it is therefore recommended that the average pay be increased to \$700 per annum.

The Division of Publications of the Department, acting in cooperation with the Bureau of Lighthouses and the Superintendent of Documents, Government Printing Office, has been endeavoring to devise some means whereby a nominal price may be placed on lighthouse publications, thus avoiding the present free and somewhat wasteful system of distribution. In arranging the details of this matter, business difficulties have arisen with private booksellers and agencies outside of the Government service, who decline to make the necessary returns of cash, stocks on hand, etc., unless a commission is allowed them on sales, following the usual commercial practice in this respect. Appropriate recommendations for legislation to overcome this difficulty are therefore submitted, providing for the sale of such publications, with the allowance of commissions under proper regulations.

Recommendation is made that authority be granted to establish and maintain post-lantern lights and other aids to navigation,

out of the annual appropriation for the Lighthouse Service, on Lakes Union and Washington, in the State of Washington. The lighting of inland waters is limited to those specifically authorized by Congress, and such authority has not been granted for the lakes specified. The Lake Washington Ship Canal, opened July 4, 1917, permits deep-sea shipping to enter these lakes, and in response to requests that lights be provided, the foregoing recommendation is submitted.

It is also recommended that the appropriation "General expenses, Lighthouse Service," be made available for rebuilding light stations and depots and buildings connected therewith. Under present authority of law, if such a structure is destroyed by storm or other accident, its rebuilding can not be undertaken without the special authority of Congress, regardless of the urgency of the case. It is in the interest of effectively maintaining the Lighthouse Service that provision for this purpose be made in the appropriation as recommended.

An appropriation for enlarging and improving the lighthouse depot, fifth lighthouse district, Portsmouth, Va., is especially urgent at this time owing to the inadequate facilities of the present depot.

This is the principal depot of the largest lighthouse district in the Service, and is the headquarters, during the greater part of the year, of five tenders and two light vessels. The total wharf frontage available for these vessels is only 240 feet, while the aggregate length of the vessels required to be tied up at the dock is over 1,000 feet. Tenders frequently lay three abreast for two or three days at a time, awaiting opportunity to discharge or receive cargo, and the delays resulting from inadequate facilities are estimated to cost the Lighthouse Service not less than \$25,000 per annum.

An immediate appropriation for improving this depot should be made because, in addition to the inconvenience and costly inefficient service with the present equipment, the fact that much of the floating equipment of the Lighthouse Service is now transferred to the Navy, and is acting with the Navy in military operations, makes the delays intolerable.

The Department contemplates the purchasing of a site adjacent to the present depot site, and lying between that site and the navy yard. This would give the lighthouse depot 243 feet additional water front on the property to be acquired, to which can

be added 120 feet obtained through closing two streets adjacent to the property making a total of 606 feet of water-front property at this lighthouse depot.

I quote below from a letter written to the lighthouse inspector, Baltimore, Md., August 14, 1917, by the commandant of the fifth naval district, Norfolk, Va., in which he reports upon the inadequacy of the present lighthouse depot:

\* \* \* I would like to say that it has been apparent to me for some time that the space available for the depot and the vessels of the Lighthouse Establishment here is entirely inadequate.

The vessels under temporary repair, or loading with supplies, have not sufficient wharf space to complete their work in the shortest possible time. Delays appear to be numerous and prolonged; and I have no doubt that the availability of the lighthouse tenders would be increased at least 25 per cent by adequate space in which to load and repair \* \* \*.

There is great need for provision by law for the retirement of employees of the Lighthouse Service who after long service have lost their ability for active duty by reason of age or disability incident to their work. This is essential to full efficiency in the administration of the Service. In the Commissioner's report for 1912 a statement was given showing the practice in a number of important foreign countries with reference to the pensioning of employees in the respective lighthouse services in common with other civil employees in those countries, from which it appears that a retirement system is in force with favorable results under all of the other governments mentioned. On April 24, 1916, the Senate unanimously passed a bill providing for the optional retirement of officers and employees of the Bureau of Lighthouses and the Lighthouse Service at the age of 65 years after 30 years' service, and compulsory retirement at the age of 70 years. The retirement pay would be at the rate of one-fortieth of the last annual pay for each year of active service, not to exceed thirty-fortieths. The bill was not acted upon by the House of Representatives and has been resubmitted in a modified form covering only field employees.

The action marked the first legislative step toward a system of retirement for the Lighthouse Service which has been earnestly recommended in previous annual reports every year since 1910. The bill had my warm indorsement as well as that of the Senate Committee on Commerce, and it is hoped that Congress may see fit to enact some remedial measure of this character into law at an early date.

On July 19, 1917, the Assistant Secretary of Commerce and the Commissioner of Lighthouses appeared at my request before the Senate Committee on Civil Service and Retrenchment in connection with a retirement system for this service. The following data were then furnished to the committee:

**FIELD EMPLOYEES OF THE BUREAU OF LIGHTHOUSES OF LONG SERVICE WHO ARE OVER 65 YEARS OF AGE.**

Age and service of employees.	Keepers.	Vessel. men.	Field force.	Total.
70 years old or more with 30 years' or more service.....	40	4	6	50
70 years old or more with less than 30 years' service.....	20	4	3	27
Over 65 years old and less than 70 with 30 years' or more service.	21	4	1	26
Over 65 years old and less than 70 with less than 30 years' service.	18	7	5	30
<b>Total.....</b>	<b>99</b>	<b>19</b>	<b>15</b>	<b>133</b>

The statements made before the committee by the aforesaid officers appear on pages 167 to 173 of the hearings of the committee of the Sixty-fifth Congress, first session. The suggestion has been made that a retirement system may properly be confined to those who risk their lives in war for the Nation. It is not entirely so confined because a retirement system exists, and wisely so, for the crews of life-saving stations of the Coast Guard service. It is pointed out, however, that the work of the field forces of the Lighthouse Service is on many occasions quite as dangerous to life and limb as is that of any other Government service, including the military ones. The records of the Service are full of cases of unselfish heroism, and the discrimination which now exists by law in favor of one Government service and against another of equal danger is a real injustice, though doubtless an unintentional one, which should be corrected as promptly as possible.

### **Saving of Life and Property.**

During the fiscal year 1917 services in saving of life and property were rendered and acts of heroism performed on 160 occasions by employees of the Lighthouse Service on vessels or at stations. A list of these is appended.

In each of these cases a commendatory letter was issued by me, and in the case of the work of the lighthouse tender *Cypress*, Capt. John P. Johnson, commanding, during the hurricane in the vicinity of Charleston, S. C., July 13-15, 1916, a letter of commendation was also issued by the Navy Department. During this storm, the services performed by the *Cypress* included the

rescue of 97 marooned persons from a low island, the placing of 2 disabled lighthouse vessels in a safe anchorage, and the rescue of the master and 21 men from the wrecked naval collier *Hector*, off Cape Romain, under most difficult circumstances.

Reference is made, for details of the work of this Bureau, to the report of the Commissioner of Lighthouses to the Secretary of Commerce, which is fully descriptive of every portion of the Service. It gives the details of the vessels employed in the Service and their cost of maintenance and gives the facts respecting special works of construction going on throughout the country. It includes in full the detailed estimates for the operations of the Service during the fiscal year ending June 30, 1919, including both maintenance and special works and the reasons for same, and contains a full statement of new works completed during the fiscal year ended June 30, 1917, and to the time of issuing this report. It will be found a substantial encyclopedia of the work of the Service during this period.

SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
1st.....	A. J. Clinch, keeper, Franklin Island Light Station, Me.	Motor boat; William Collamore, owner.	Towed disabled boat with occupant to shore.
	J. B. Thurston, keeper, Fort Point Light Station, Me.	Motor boat.....	Towed disabled boat, with 8 men on board, to safe anchorage.
	Do.....	.....do.....	Towed disabled boat, with 1 man aboard, to safe anchorage.
	A. B. Hamor, assistant keeper, Egg Rock Light Station, Me.	Motor boat; Walter Rath in charge	Towed disabled boat to Bar Harbor, Me.
	Tender Zizania.....	.....	Rescued from drowning 2 men fallen overboard from Grand Trunk Wharf, Portland, Me.
	E. H. Pierce, Doubling Point Range Light Station, Me.	.....	Rescued from drowning insane man who jumped from wharf at Bath, Me.
	Tender Zizania.....	Sloop.....	Rescued 2 men marooned on Pettis Rock, Kennebec River, Me., and transported them to Bath, Me.
	Tender Hibiscus.....	Schooner Mary A. Hall; Capt. George Olsen.	Towed lumber-laden schooner, in dangerous position, to anchorage in Portland Harbor, Me.
	W. P. Kent, keeper, Egg Rock Light Station, Me.	Motor boat.....	Towed disabled boat, with 2 fishermen aboard, to station.
	A. C. Holt, keeper, Deer Island Thorofare Light Station, Me.	Schooner Sarah and Lucy; Capt. Perry. Steamer Minnehaha.	Assisted in floating schooner, ashore on rocks off Andrews Island, Me.; also assisted in towing disabled steamer Minnehaha to place of safety.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
1st .....	J. E. Purington, keeper, Nash Island Light Station, Me.	Freighter B. B. W.; Jonesport Transportation Co.	Assisted in recovering freight and furnished crew with lodging and meals.
	A. C. Holt, keeper, Deer Island Thoro fare Light Station, Me.	Motor boat; Everett Gross, owner.	Towed disabled boat to Stonington, Me.
	Portland Light Vessel No. 74, Me.	Motor boat; Charles Burgess, owner.	Furnished boat with batteries, etc.
	Do .....	Motor boat; George McDonald, owner.	Hoisted boat and furnished wire and tools to tighten propeller.
2d .....	E. C. Mott, keeper, Deer Island Light Station, Mass.	Power boat Marion; Albert Moses, owner.	Towed disabled boat to safe anchorage, repaired engine, and furnished food and dry clothing to 3 occupants.
	Tender Azalea .....	Schooner yacht Hope-well, of Providence, R. I.	Pulled off stranded schooner and towed her to deep water.
	Do .....	Knockabout Nellie, of Providence, R. I.	Towed disabled boat to Vineyard Haven, Mass.
	Nantucket Shoals Light Vessel No. 85, Mass.	Schooner Victor and Ethan, steamers Stathene, West Point, and Christiana Knudson.	Furnished food and lodging to 113 shipwrecked men until arrival of United States destroyers.
	Stone Horse Shoal Light Vessel No. 5, Mass.	Fishing schooner Pontiac.	Furnished lodging to captain and 16 men of grounded vessel.
	T. Poole, laborer, Lovells Island Depot, Mass.	.....	Rescued from drowning, boy fallen off wharf.
	H. L. Thomas, keeper, Nantucket (Great Point) Light Station, Mass.	Schooner Roger Drury, of Boston, Mass.	Furnished food and dry clothing to captain and 5 men who abandoned sinking vessel.
	L. B. Clark, keeper, Cuttyhunk Light Station, Mass.	Power boat Champion of Newport, R. I.	Assisted in landing boat, with 2 men aboard, driven ashore by gale.
	Tender Azalea .....	Dory .....	Towed to pier dory, with 3 men aboard, caught in ice jam.
	H. L. Thomas, keeper, Nantucket (Great Point) Light Station, Mass., C. Stoll, assistant keeper.	Steamer A. T. Serrell, of Newport, R. I.	Assisted ashore crew of 8 men of disabled vessel, caught in ice pack, and quartered crew at light station until arrival of Coast Guard.
	G. Bartlett, first officer, tender Azalea.	.....	Rescued man from overturned dory and placed him aboard barge.
	Great Round Shoal Light Vessel No. 86, Mass.	Dory from schooner W. H. Moody, of Gloucester, Mass.	Rescued 2 men in exhausted condition, adrift in blizzard 30 hours, and furnished them food and lodging.
	G. A. Faulkner, keeper, Palmer Island Light Station, Mass.	.....	Rescued from drowning 2 men from overturned skiff and cared for them until arrival of harbor police.
	Boston Light Vessel No. 54, Mass.	Motor boat .....	Rescued from drowning 3 fishermen in motor boat and furnished them food and lodging.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
sd.....	A. A. Howard, keeper, Ipswich Range Light Station, Mass.	Schooner George M. Warner, of Yarmouth, N. S.	Furnished food, dry clothing, and lodging to captain and crew.
jd.....	Tender Pansy.....	Portland packet.....	Rescued captain and 3 men in exhausted condition in small boat from abandoned vessel, grounded on Romer Shoal, and recovered vessel.
	Do.....	Motor boat, of Poughkeepsie, N. Y.	Recovered disabled motor boat with 3 boys aboard, and towed her to dock.
	J. F. Woods, keeper Saybrook Breakwater Light Station, Conn.	Speed boat.....	Towed disabled speed boat, with 2 occupants aboard, to station.
	Do.....	Schooner Silver Queen..	Rendered aid to captain with crushed hand, and cared for him until arrival of doctor.
	K. Hanson, keeper, J. J. Price, first assistant keeper, and S. C. Wright, second assistant keeper, Absecon Light Station, N. J.	Yacht Cerenty.....	Assisted in getting distressed yacht off bar.
	J. H. Woods, keeper, Saybrook Breakwater Light Station, Conn.	Sloop Jolly Tar.....	Pulled sloop off shore on west side of breakwater with power boat.
	W. M. Chapel, keeper, Plum Island Light Station, N. Y.	Tug S. L. Hommedieu..	Rescued captain and wife, adrift from sinking tug, in open boat, without oars.
	E. E. Gildersleeve, keeper, Saybrook Point Light Station, Conn.	.....	Extinguished fire in cottage.
	J. A. Miller, keeper, Bridgeport Harbor Light Station, Conn.	Sloop Samuel C. Bond..	Assisted in getting sloop off breakwater.
	Tender Pansy.....	Yacht Trio; John Pier-son, owner.	Towed yacht, in sinking condition, with 2 occupants aboard, to yacht basin, South Brooklyn, N. Y.
	E. M. Grant, keeper, Stepping Stones Light Station, N. Y.	Yacht Damascara; David M. Myers, owner.	Rescued owner and guest from disabled yacht and furnished them meal.
	S. Dodge, keeper, W. H. Clark, first assistant keeper, Block Island (Southeast) Light Station, R. I.	U. S. Army hydroplane.	Assisted in saving damaged hydroplane, which alighted in surf near station, and in repairing same, and furnished occupants lodging and clothing.
	Tender John Rodgers.....	Launch Ellis, U. S. Engineers, New London, Conn.	Assisted in saving launch, near sinking, at Customhouse Wharf.
	W. F. Rhodes, keeper, F. E. Thompson, assistant keeper, Greens Ledge Light Station, Conn.	Oyster boat.....	Assisted in extinguishing flames.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
3d.....	Tender Myrtle.....  W. J. Murray, keeper, S. Kendzia, first assistant keeper, J. F. Newman, second assistant keeper, Little Gull Island Light Station, N. Y. Cornfield Point Light Vessel No. 48, Conn.	Motor boat Try On... ..  Auxiliary sailboat; C. E. Beach, owner.  Small power boat.... ..	Towed disabled motor boat, with 5 men aboard, to shore. Towed boat, adrift, to station.  Towed small power boat, adrift, with 1 occupant, to Saybrook Point.
4th.....	W. H. Schellenger, keeper, C. H. Hickman, second assistant keeper, Harbor of Refuge Light Station, Del.	Motor boat.....	Recovered disabled motor boat, with 6 men aboard, blown off shore from light station.
5th.....	W. J. Tate, keeper, North Landing River, Currituck Sound, Coinjock Bay, and North River Aids, N. C. Tender Jessamine.....	Launch.....  Schooner Jessie Irving...	Rendered assistance to disabled launch.  Floated schooner, ashore on Kent Island Shoal, Md.
	W. J. Tate, keeper, North Landing River, etc., aids. Do.....	Schooner Hobson..... Freighter R. C. Beaman.	Assisted in floating schooner, ashore near station. Rendered assistance to disabled freighter.
	Do.....	Boat Murial Dean.....	Assisted in floating boat.
	Do.....	Launch.....	Assisted in making emergency repairs to launch.
	Do.....	Yacht Idlewell.....	Piloted yacht which had lost her way.
	Do.....	.....	Assisted in repairing disabled aeroplane, and provided shelter for occupants.
	Do.....	Motor boat.....	Aided disabled boat and assisted in repairing same.
	Do.....	.....do.....	Towed disabled motor boat to safe harbor.
	Do.....	North Carolina Fisheries Commission boat Gretchen.	Assisted in floating boat, conveyed State Fish Commissioner, to Coinjock, N. C.
	Tender Maple.....	Schooner Rattler: Capt. Frank Gibson.	Towed disabled and sinking schooner to harbor and rescued complement of 4 men.
	J. F. Hudgins, keeper, Neuse River Light Station, etc., N. C.	Launch.....	Rescued 9 persons from disabled launch.
	Tender Maple.....	Steamer Severn and bug-eye Mary E. Foubie.	Rendered assistance to steamer and bug-eye, which collided.
	W. H. Davis, keeper, Lazaretto Lighthouse Depot, Md.	.....do.....	Went to assistance of those on board these boats.
	C. C. Tyler, keeper, Great Shoals Light Station, Md.	Launch.....	Rendered assistance to 3 persons in disabled launch and furnished them food and shelter.
	Tender Jessamine.....	.....	Rescued man from drowning.



## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc. aided.	Nature of assistance.
5th .....	W. M. Midgett, assistant keeper, Love Point Light Station, Md.	.....	Assisted in rescuing drowning man.
	W. J. Tate, keeper, North Landing River, etc., aids, N. C.	Yacht.....	Floated stranded yacht.
	Do.....	Yacht Abeela, of New York.	Repaired engine of yacht.
	G. M. Willis, sr., keeper, Cedar Point Light Station, Md.	Launch Jane.....	Floated launch, aground on bar near light station and furnished lodging to crew.
	Tender Maple.....	Oyster boat Lady Eleanor.	Towed boat, anchored with masts and sails overboard, to Baltimore, Md.
	Do.....	Schooner S. E. Lankford	Floated schooner, ashore at Mathias Point, Md.
	Do.....	Bateau Princess.....	Went to assistance of bateau and landed crew at Annapolis, Md.
	Do.....	Schooner Ada J. Campbell.	Went to assistance of schooner, with decks awash, and towed her to safe anchorage.
	Tender Orchid.....	Tug W. S. Embrey, of New York.	Towed disabled tug, with 5 persons aboard, to safety.
	W. Newton, keeper, Harbor Island Bar Light Station, N. C.	Schooner Lacy.....	Floated and towed schooner to harbor.
	G. G. Johnson, assistant keeper, Old Plantation Flats Light Station, Va.	Motor boat.....	Towed disabled motor boat to station, furnished occupants food, and towed boat to Cape Charles, Va.
	T. D. Quidley, keeper, Neuse River Light Station, etc., N. C.	Freight boat Olive.....	Towed heavily laden freight boat to safe harbor.
	H. S. Moore, keeper, Jones Island Light Station, Md.	Skiff.....	Rendered assistance to occupants of skiff, caught in ice near station and furnished them food and lodging.
	Tender Laurel.....	Motor boat.....	Towed disabled motor boat, containing 7 persons, to Washington, D. C.
	Tender Holly.....	Schooner Thomas J. Seward.	Pulled schooner, ashore on Point Breemo, Va., into deep water.
6th .....	T. H. Baum, keeper, L. V. Gas-kill, assistant keeper, Long Shoal Light Station, N. C.	Power boat E. R. Daniels.	Assisted disabled power boat and helped repair engines.
	C. A. Sterling, keeper, Craney Island Light Station, Va.	Yacht Joan III, of Norfolk, Va.	Rescued member of crew from drowning and towed yacht to safe harbor.
	Tender Cypress.....	U. S. S. Hector.....	Rescued master and 30 others left on wrecked steamer.
	Do.....	British S. S. Oak Branch	Picked up moorings off Charleston Harbor and delivered them to vessel's agents in Charleston, S. C.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
6th.....	Tender Cypress.....	Motor boat Acme.....	Towed disabled boat, with 4 men aboard, to Charleston, S. C.
	Tender Mangrove.....	British S. S. Nevisian...	Assisted in floating vessel grounded on St. Simon Bar, Ga.
	Do.....	Power boat Kurkimah; W. G. Hinson, owner, James Island, S. C.	Picked up boat, adrift off Port Sumter, and delivered it to Charleston Lighthouse Depot.
	Tender Snowdrop.....	Small boat.....	Rescued party of 11 persons from perilous position in Winyah Bay, S. C., and transferred them to Georgetown, S. C.
	A. F. Wichmann, keeper, Cape Romain Light Station, S. C.	Barge Northwest.....	Assisted captain and 4 others washed ashore.
	J. Cromley, keeper, R. H. Cromley, assistant keeper, Sapelo Light Station, Ga.	Schooner Perry Selser...	Assisted schooner in distress off Sapelo Light Station and secured tug for tow to Brunswick, Ga.
	L. H. Bringloe, keeper, J. Grillo, second assistant keeper, Charleston Light Station, S. C.	Small boat.....	Assisted 2 fishermen in breakers in reaching shore near light station.
	T. Knight, keeper, J. H. Minges, first assistant keeper, W. E. McCreary, second assistant keeper, Hillsboro Inlet Light Station, Fla.	Motor boat.....	Rescued 3 persons from upset motor boat and furnished them clothing and food.
	T. Knight, keeper, W. E. McCreary, second assistant keeper, Hillsboro Inlet Light Station, Fla.	Barge Hildegard; Alfred Clement, owner, New Orleans, La.	Telegraphed to Key West, Fla., for aid for grounded vessel.
	R. Heiser, keeper, Jupiter Inlet Light Station, Fla.	S. S. Sangstad; United Fruit Co., owners, Boston, Mass.	Requested aid by wireless for vessel ashore off Jupiter Inlet, Fla.
7th.....	F. Traugott, keeper, Hunting Island Light Station, S. C.	Tug Passport; Savannah River Lumber Co., owners, Savannah, Ga.	Advised owners by telegraph of disabled condition of tug near light station.
	Tender Snowdrop.....	Greek schooner Maria Louisa.	Rescued 5 members of crew from wreck on Dry Tortugas, and transported them to Key West, Fla.
	Tender Ivy.....	do.....	Assisted in trying to pull wreck off shoals.
8th.....	M. W. Streckert, keeper, O. H. Beadnell, second assistant keeper, Sand Island Light Station, Ala.	.....	Maintained light during hurricane.
	M. Brown, first assistant keeper, Sand Island Light Station, Ala.	.....	Saved property during hurricane.
	T. P. Roberts, assistant keeper, Aransas Pass Light Station, Tex.	.....	Maintained light and protected property during hurricane.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
8th....	G. R. Smith, keeper, L. R. Smith, assistant keeper, Red Fish Bar Cut Light Station, Tex.	Schooner Adele.....	Rescued crew of 2 men from foundered vessel and furnished them food and clothing.
	Tender Sunflower.....	S. S. Standard; Standard Oil Co., owners, Bayonne, N. J.	Floated vessel, grounded in South Pass, La.
	J. W. Sprinkle, laborer in charge, Pass Aux Herons Lights, Ala.	Launch Bernice, of Point Clear, Ala.	Assisted disabled launch.
	G. R. Smith, keeper, L. R. Smith, assistant keeper, Red Fish Bar Cut Light Station, Tex.	Launch Emmy.....	Assisted disabled launch, and furnished provisions and water to occupants.
	A. Rodi, keeper, South Pass East Jetty Light Station, etc., La.	U. S. Torpedo Boat Flusser.	Assisted in landing crew of vessel, stranded on beach near light station.
	J. H. Portman, keeper, F. A. Schrieber, assistant keeper, Round Island Light Station, etc., Miss.	Motor boat.....	Assisted occupants of disabled boat and furnished them food and shelter.
	M. W. Streckert, keeper, M. Brown, first assistant keeper, O. H. Beadnell, second assistant keeper, Sand Island Light Station, Ala.	Launch; Aug. Writz, owner.	Towed disabled launch to place of safety and furnished occupants fuel, food, and shelter.
	F. A. Schrieber, assistant keeper, Round Island Light Station, etc., Miss.	Small sailboat.....	Towed disabled boat to entrance of Pascagoula River.
	G. R. Smith, keeper, Red Fish Bar Cut Light Station, Tex.	Motor tug Fortune.....	Rescued crew of 3 men from wreck of motor tug.
	B. A. Dissett, first assistant keeper, Toledo Harbor Light Station, Ohio.	Launch.....	Towed disabled launch to light station and furnished food to occupants.
10th....	Do.....	Yacht Dorel.....	Towed sunken yacht to light station and righted and towed her to Toledo, Ohio.
	G. F. Ferguson, keeper, Fort Niagara Light Station, N. Y.	.....	Assisted in rescuing man adrift in the ice on Lake Ontario.
	C. Fitzmorris, keeper, West Sister Island Light Station, Ohio.	Yacht Luella; P. C. and C. A. Peters, owners.	Rescued 6 persons from capsized yacht, assisted in righting yacht, and furnished food and clothing to occupants.
	Do.....	Launch Baby Rambler..	Furnished shelter and dry clothing to 2 men en route to Toledo, Ohio.
	Do.....	Launch Exalta.....	Furnished 4 men from disabled launch food and lodging.
	D. D. Hill, keeper, Cross Over Island Light Station, N. Y.	Barge Brighton; Montreal Transportation Co.	Assisted in removing crew and personal effects from barge, grounded near station.
	F. Ritter, keeper, Sandusky Bay Inner Range Light Station, Ohio.	Launch.....	Towed launch to safety.
	Do.....	do.....	Towed disabled launch, with 7 persons aboard, to Sandusky, Ohio.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
10th....	A. Shaw, jr., keeper, Presque Isle Light Station, Pa.	.....	Prevented spreading of fire in vicinity of station.
11th....	W. A. Burke, keeper, Saginaw River Range Light Station, Mich.	Sail boat; Earl Beutel, owner.	Towed disabled boat to safety.
	L. McDonald, first assistant keeper, E. C. Towns, second assistant keeper, Port Austin Reef Light Station, Mich., D. McDonald, second assistant keeper, Detour Light Station, Mich.	.....	Assisted in rescuing 3 fishermen, adrift on ice.
	L. McDonald, first assistant keeper, E. C. Towns, second assistant keeper, Port Austin Reef Light Station, Mich.	Gasoline fish boat; I. S. Osborn, owner.	Towed disabled boat to safety.
	H. Keondway, second assistant keeper, Fourteen Mile Point Light Station, Mich.	Motor boat Florence.....	Do.
	A. McLean, keeper, C. G. Wright, second assistant keeper, Huron Island Light Station, Mich.	Launch Petrel.....	Towed disabled motor boat, adrift in a heavy sea, to safety, and furnished occupants food, lodging, and dry clothing.
	W. G. Marshall, keeper, Windmill Point Light Station, Mich.	.....	Rescued man from drowning.
	F. G. Sommer, keeper, Detour Light Station, Mich.	Launch Adolph; Spencer M. Hill, owner.	Towed disabled launch to safety.
	F. Warner, keeper, Birch Point Range Lights, Mich.	Motor boat; R. V. Duncan, owner.	Recovered disabled boat, adrift in violent gale.
	N. Abear, keeper, Frying Pan Island Light Station, Mich.	Tug Rambler.....	Furnished food to passengers of tug caught in ice and brought passengers and mail ashore.
	Do.....	Motor boat; M. J. Address, owner.	Towed disabled boat to safety.
	E. C. Byrne, first assistant keeper, Point Iroquois Light Station, Mich.	Motor boat; John Evans, owner.	Towed leaky boat to safety and furnished occupants food and lodging.
	C. T. Davis, keeper, Copper Harbor Range Lights, Mich.	Canoe.....	Furnished food and dry clothing to man from capsized canoe.
12th....	T. E. Martin, assistant keeper, Michigan City Light Station, Ind.	.....	Rescued from drowning man and boy fallen off pier.
	T. J. Armstrong, keeper, Michigan City Light Station, Ind.	.....	Rescued from drowning boy fallen off pier.
	O. C. McCauley, keeper, C. Lonnis, first assistant keeper, Squaw Island Light Station, Mich.	Launch Phyllis; J. Brown, owner, Scotts Point, Mich.	Towed disabled boat with 2 occupants ashore.
	J. H. Sullivan, second assistant keeper, White Shoal Light Station, Mich.	Motor boat.....	Towed disabled motor boat into harbor.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employees rendering service.	Vessels, etc., aided.	Nature of assistance.
15th....	E. H. Cornell, keeper; J. Fitzgerald, assistant keeper; Potawatomi Light Station, Wis.	Steamer Peter Reiss.....	Notified Coast Guard and delivered messages to stranded steamer.
	O. C. McCauley, keeper, Squaw Island Light Station, Mich.	Fish tug Margaret McCann.	Towed disabled boat 5 miles into harbor.
	R. F. Wright, first assistant keeper, Manitowoc Light Station, Wis.	Launch Manowis.....	Assisted in releasing launch, which had beached.
	J. W. Barrand, mate, R. Peterson, cook, Eleven Foot Shoal Light Vessel No. 60, Mich.	.....	Rescued from drowning man fallen into water from the ice.
	L. Gronning, laborer, Chicago Pierhead Range Light Station, Ill.	.....	Rescued from drowning man fallen off pier.
	W. Donovan, first assistant keeper, S. O. Thorlien, laborer, Chicago Harbor Light Station, Ill.	Launch Thetis, city of Chicago.	Pulled stranded launch off breakwater and towed her to light station; notified Coast Guard.
	P. Sheridan, keeper, Chicago Harbor Light Station, Ill.	Launch May.....	Furnished gasoline to launch, in danger of drifting on breakwater; towed her to another vessel.
	L. Gronning, laborer, Chicago Pierhead Range Light Station, Ill.	.....	Assisted in rescuing man blown off pier by wind.
	J. K. Robinson, keeper, Calumet Harbor Light Station, Ill.	.....	Rescued woman from drowning.
	J. H. Nelson, first assistant keeper, Calumet Harbor Light Station, Ill.	Motor boat Sea Gull, U.S. Engineer Department.	Assisted in rendering aid to disabled boat.
	E. C. Sterritt, keeper, Twin River Point Light Station, Wis.	Motor boat Ann Ella....	Notified Coast Guard, who rendered assistance to disabled motor boat.
	R. W. Johnson, keeper, M. Telford, first assistant keeper, North Manitou Light Station, Mich.	Motor boat Teal; Peter Stormer, owner.	Towed disabled boat, with 3 men aboard, to shore, and furnished them gasoline.
16th....	Tender Fern.....	S. S. Admiral Farragut, Pacific Alaska Navigation Co., E. D. Hickman, master.	Removed passengers and assisted in pulling ground vessel clear on flood tide.
	D. O. Kinyon, keeper, Guard Island Light Station, Alaska.	Motor boat.....	Towed to station.
	R. McKlem, keeper, G. Alexius, first assistant keeper, J. C. Jespersen, second assistant keeper, Eldred Rock Light Station, Alaska.	Fish trap Watchman, Chilkoot Cannery.	Conveyed injured man to station and took him to Haines, Alaska, for medical treatment.
	D. O. Kinyon, keeper, Guard Island Light Station, Alaska.	Launch Holdahl and....	Furnished occupants gasoline.
	S. G. Olsen, keeper, E. Pecor, first assistant keeper, Cape Hinchinbrook Light Station, Alaska.	.....	Furnished shelter, clothing, and subsistence to shipwrecked and stormbound native mail carriers.
	S. F. Shepard, keeper, Mary Island Light Station, Alaska.	Motor boat Retriever; Chas. Baker, owner.	Furnished gasoline to occupants.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
16th....	Tender Fern.....	Barge Henry Villard; James Griffiths & Sons, owners.	Towed barge into Ketchikan, Alaska.
17th....	Columbia River Light Vessel No. 88, Oregon. J. E. Thomas, keeper, H. J. Wil- liams, assistant keeper, Ediz Hook Light Station, Wash. L. A. Pettersen, keeper, West Point Light Station, Wash.	Fishing boat Nara..... Launch..... Sailboat Mist; George De Britz, owner.	Rendered assistance to boat con- taining 2 men. Towed disabled launch containing 2 men to safe anchorage. Towed disabled boat off rocks near station to Ballard, Wash., for re- pairs.
18th....	G. A. Cobb, keeper, T. S. Thom- son, assistant keeper, Hum- boldt Bay Fog Signal Station, Cal.	U. S. Submarine H-3...	Assisted in rescuing 27 men from vessel ashore.
19th....	Tender Columbine..... Do.....	..... Schooner Muriel.....	Searched for Army launch, lost off Oahu Island. Towed grounded schooner with 2 lighters to safe anchorage, and floated her by lightening cargo.

## COAST AND GEODETIC SURVEY.

(Dr. E. LESTER JONES, *Superintendent.*)

In my last report the reorganization of the office force of this Bureau was mentioned and the need was urged of an increase in that force, of more and better equipment, and of a proper building in which to carry on the work. These subjects are again referred to herein.

By the act of Congress approved May 22, 1917, the officers of the Coast and Geodetic Survey were given commissioned rank. In the same act and by Executive proclamation dated September 24, 1917, the steamers *Surveyor*, *Isis*, and *Bache* were transferred to the service and jurisdiction of the Navy Department, together with 18 officers and 111 men. Twenty commissioned officers, in addition to those on these ships, were also transferred to the jurisdiction of the Navy Department. At the same time 29 officers, 5 computers, and 5 draftsmen were transferred by Executive order to the service and jurisdiction of the War Department. The names and rank of the officers thus transferred appear in full in the Executive order. (Reference is made to the Coast and Geodetic Survey Bulletin No. 28 for September, 1917.)

On July 19, 1917, the Chinese Government Institute of Military Surveying requested, through the American minister at Peking and the Secretary of State, assistance for the employment of an American for the position of professor of triangulation surveying. The request states that the person appointed must be a graduate of an American university course covering the subjects stated below, and adds:

The appointee must have had several years experience in geodetic work in the United States Coast and Geodetic Survey and must have ability to teach higher geodesy with emphasis upon the theory and application of geodetic triangulation and precise leveling. He must also be able to teach the theory and application of the method of least square and of astronomy, including refined latitude and longitude civil engineering.

Nominations were in due course made pursuant to the above request.

The detailed report to me of the Superintendent of the Coast and Geodetic Survey gives an adequate picture of the work of this

fine scientific service. The question is sometimes asked when the work of the Coast and Geodetic Survey will be done, in the apparent thought that it deals with a fixed and settled condition which can be measured in a given time. The answer, of course, must be that the work of the Coast and Geodetic Survey will be done when the rivers cease to flow and the ocean currents cease to change. So long as rivers bring silt to the sea and coastwise contours change with the tides and ocean currents, just so long will the work of this service be required.

It is a very unfortunate fact, but it is a fact to which attention is specially directed in Appendix D of this report, that at the time when our coasts surveys were needed more than ever before, the equipment for making those surveys is smaller than it has been for years. It is also unfortunate that as regards the vital wire-drag work, on which alone dependence can be placed to secure safety from undersea dangers on many portions of our coasts, there is no equipment whatever in the possession of the Government in the way of launches and boats with which to do the work. Dependence has to be placed upon the casual hiring of such launches as may be here and there available, a process always costly, highly wasteful, and sometimes impossible. A case is cited herein where important wire-drag work required for the Navy could not be done because the Government had not launches of its own and no private ones could be hired. It is earnestly hoped that the repeated requests made to provide the service with launches in order that the waste of money might be stopped, upon the one hand, and the work certainly done, upon the other, may be favorably heard at the coming session of Congress.

It seems best to give now an outline of the field work of this service in gathering the data requisite to make the charts of our coasts and to provide the information for which the service is constantly asked by navigators, engineers, and others. At the same time it is well to refer to the present state of our knowledge of our coasts, and to outline in a general way what has been done and must be done to make our waterways safe for navigation.

#### **Plan of the Field Work.**

In the language of the organic act creating the Bureau, enacted during the administration of President Jefferson, its purpose was stated to be \* \* \* "to cause a survey to be taken of the coasts of the United States \* \* \* for completing an accurate chart of every part of the coasts within the extent aforesaid."



From this origin the work of the Bureau, as its name implies, has been enlarged into two distinct fields of activity. They are surveying of the coasts, called hydrographic surveys—that is, ascertaining the depths of the coastal waters—surveying in the interior, called geodetic surveys, which consist of the establishment of the control or framework on which all land surveys, Federal, State, municipal, and industrial are or should be based.

The submarine is not the only or the worst enemy to American vessels. The pinnacle rock, the coral reef, the newly formed shoal, the unknown current, these have cost the American marine far more than has the submarine. Much less than one-tenth of the outlay made to defend against the undersea boat would make our marine secure from a far greater foe.

#### **General Classes of the Coasts.**

The nature and formation of the coast determines the method of making the hydrographic surveys. Broadly speaking, along the coasts of the United States and their possessions, are found three general classes of shore formation, each presenting a different problem to the hydrographic surveyor.

#### **Atlantic Coast.**

From the eastward line of Maine to Sandy Hook, outside New York Harbor, the coastal formation is usually that of a rocky bluff, or shelving rocks extending to and beneath the waters, strewn with boulders.

From Sandy Hook, to the vicinity of Palm Beach, Fla., the shores are sandy without prominent bluffs, shelving rocks, and detached boulders.

From Palm Beach around the shores of Florida to Cedar Keys coral reefs are characteristic of the coast line. Some of these reefs take the form of small islets, known as "keys"; others are submerged but reach so close to the surface that they are grave menaces to navigation.

#### **Gulf Coast.**

From Cedar Keys to the Mexican boundary the coasts are largely sandy, though presenting different characteristics from the sandy stretch between New York Harbor and Palm Beach, in that immense sand bars have been thrown up in places making great inland bodies or stretches of water through which commerce must travel to reach the Gulf.

**Porto Rico Coast.**

Leaving, now, the continental United States, there remains a long stretch of shore lines touched by the Atlantic Ocean and the Caribbean Sea. They are the coasts of Porto Rico and the outlying islands. Off these shores (with the exception of the north and northwest coasts of Porto Rico, which face the open Atlantic Ocean) the depth increases gradually from the shores to the open waters, with the result that the bottom is covered with coral growths, and the dangers to navigation are the coral reefs as on the coast of Florida. On the north and northwest coasts of Porto Rico the shores are exposed to the open ocean, the depths are abrupt, therefore the coral growths along this stretch of the coast offer no dangers to navigation.

**Pacific Coast.**

The whole Pacific shores of the United States may generally be described as rocky, with here and there stretches of beaches resulting from coastal degradation.

**Alaskan Coast.**

The shores of Alaska, from their southernmost point, at Dixon Entrance, to the neighborhood of Bristol Bay, are rocky, with here and there stretches of sandy beach. Emphasis must be placed on the precipitous rocky shores of southeastern Alaska, which consist almost entirely of elevated islands and peninsulas, carved by glacial action, and separated by narrow and steep fiords. Here was found the inspiration for that term "pinnacle rock," which aptly describes the dangerous instrument so well designed by nature to tear a hole in a vessel and send her to the bottom.

Passing through these waters the traveler sees on every hand rugged mountain ranges whose profiles present a bewildering confusion of sharp, jagged peaks of various heights. Let him then imagine these same topographic features duplicated in the waters beneath him, the tops of the highest peaks appearing above the surface in the form of precipitous rocky islets, those of slightly less elevation rising to within a few feet of the surface, while others still lower rise but slightly above the bottom.

With this picture in mind we have some conception of the problem for the hydrographic engineer to discover and chart these hidden dangers rising up from great depths waiting to rip open the bottom of the unfortunate ship that passes their way. To make matters worse, the navigator who may detect other dangers to his vessel with some accuracy is without means of divining the presence of this hidden danger of the sea. There is no break in the water, no ripple on the surface above it. There is absolutely no indication of this hidden danger.

From Bristol Bay, stretching away to the northeastern point of Alaska, the coast line is composed of sand beaches and mud flats.

### **Pacific Islands.**

Next we have the coasts of the Hawaiian and the Philippine Islands which must be surveyed by this Bureau.

The islands of each of these groups came into existence through volcanic action. Therefore they have usually abrupt shores which drop off into great depths. The water has a temperature which promotes coral growth where great depths do not occur. There are extensive stretches of these island shores where the coral reefs require the same close surveys that are necessary on the coasts of Florida and Porto Rico. This is a general statement which suffices now, but the coasts of the Hawaiian and Philippine Islands will later be discussed in detail.

Besides these two main groups in the Pacific, there is the small island of Guam, of volcanic origin, with its shores and coral beds to be surveyed, and on the Atlantic coast the newly acquired Virgin Islands of the United States.

### **Panama Canal Region.**

There remain, before we have completed a brief review of the coast lines that fall to the lot of this Bureau to survey, two other areas, one on the Pacific coast and the other on the Atlantic coast. They are the approaches to the Panama Canal. While these are not extensive in area, they are destined through the great amount of steamship traffic that will pass through the canal, to become of importance and will require searching examinations.

The approach on the Atlantic side presents no great problem. There are some coral reefs and here and there beds of rocks protruding above the sediment from the Chagres River that has in the course of time spread a mantle over the hard bed of the approach to the canal.

The Pacific entrance to the canal is a more difficult problem for the hydrographic engineer. Here are found conditions not unlike those of southeastern Alaska, except that the unexpected isolated peaks of rocks found in the ocean bed at the entrance to the canal, and for a considerable distance seaward, had their origin in volcanic activity, and the conformation of the bed of this approach permits a fairly accurate prediction that dangers may be found.

### **Conditions of the Hydrographic Surveys.**

To show the problem which the Coast and Geodetic Survey has ever before it, it is necessary to outline the present condition of the surveys of the coasts.





An examination of the surveys of any important harbor where the areas are unchangeable will show that generally at least two different surveys have been made, each adequately meeting the needs of the time when it was made, and each quite insufficient for the needs of succeeding times.

The deepest draft of merchant vessels ranged from 12 feet in 1825 to 20 feet in 1850. These vessels were sailing ships, which in order to enter any harbor against an adverse wind, must beat back and forth across the harbor. Therefore, they did not so much require one deep, clearly defined channel as the knowledge of any dangerous shoal areas.

From 1850 to 1895 the draft of the deepest merchant vessels increased from 20 feet to about 30 feet, and most of the commerce was carried in steam-powered vessels which could keep to a defined channel. The draft of merchant vessels has continued to increase until now a depth of 40 feet is required for some of them. See illustration facing this page. Long ago the natural channels that existed in and to many of the harbors have been either deepened by dredging or abandoned and new channels dredged. One of the important problems now before the hydrographic engineer is to find, both in the deep channels and the shoaler areas, those obstructions which, consisting of isolated rocks or bowlders, are of such limited extent that they have been missed by all previous surveys made with the hand lead line.

*Inshore waters, Canadian border to New York.*—The coast of New England throughout its length presents practically one uniform problem to the hydrographic engineer. Surveys of varying degrees of completeness have been made of the entire area, and it is possible for navigators to select channels which are apparently safe. They would be of ample depth if it were not for the ice-worn granite rocks of Maine and the bowlders deposited by the great ice fields from Buzzards Bay to New York, which alike form menaces to navigation. The lead line can not find without assistance dangers of this character. The wire drag alone is able to locate all these obstructions.

Ultimately, every bay and river must be surveyed by this method. For the present it will be necessary to continue the practice of confining the work to the important channels and approaches to the chief ports. Even this represents an immense amount of work necessary to be done without delay.

*Offshore waters, Maine to New York.*—The Gulf of Maine may be considered as lying to the westward of meridian 67° 00' and

extending to Nantucket Shoals. This entire area has been surveyed but the surveys are inadequate. Not only are the soundings obtained insufficient but many of them are not located correctly on the charts. A good example of this is the discovery several years ago that only one shoal rock exists on Cashes Ledge where two were charted, and that Sigsbee and Ammen rocks formerly shown 4 miles apart are really the same rock.

Extending eastward from Nantucket Sound is an immense shoal area, consisting of sand ridges which are shifted by the waves and currents. Nantucket Shoals extend about 50 miles offshore, then there is a deep channel, and then comes the great shoal area of Georges Bank, which has several very shoal ridges. It is readily seen that it is important to keep the channels surveyed and to examine the adjacent shoals to detect changes, but it may be asked what is the use of surveying such areas as Nantucket Shoals which vessels are careful to avoid. It is first necessary to be certain that the outer limits of these shoals are kept clearly defined so that they can be avoided. Second, the shoals are important fishing grounds. Third, more careful surveys may develop safe channels for coastwise navigation, which are now indicated on the charts but are unsafe to use because of incomplete surveys.

The existing surveys are nowhere adequate and are particularly subject to wrong locations because of the strong and variable currents. The shoals are so numerous and the channels so intricate that a difficult problem is presented in their examination by sufficiently accurate methods. There is scarcely any part of our coast where correct soundings are of more importance than in the approach to New York from the eastward, as all trans-Atlantic steamers bound for that port pass over this area. Many of them have to depend on soundings for safety. A fairly good survey of this area is available, but additional work should be done by modern methods in the portion out of sight of land, so that the enormous traffic will be protected.

*Inshore waters, New York to Florida Reefs.*—New York Harbor has had a recent survey, but as it is an area subject to change, it will require a survey, at least in part, every few years. There have been as many as 253 changes required in one year on the chart of New York Harbor.

Along most of the coast of New Jersey, the character of the bottom is such that the exact existing depths should be ascertained beyond all doubt, particularly as shoals dangerous to coastwise

traffic have been reported from time to time. The only reliable surveys along this stretch of coast have been made in connection with searches for these reported shoals. Eastward of Cape May are shoals which need resurvey.

Delaware Bay has as its marked characteristic a series of narrow, fairly deep channels separated by long narrow shoals. These shoals change. A resurvey is needed now and one should be made every 10 years in the entrance and at longer intervals in the upper bay. While dredged channels are maintained for most of the distance from the entrance of the bay to Philadelphia, vessels of moderate draft use the other channels. In view of the importance of the cities at the head of the bay and on the river, it is highly important that the needed survey of Delaware Bay be made so that a chart of the present standard can be issued.

From Delaware Bay entrance to Chesapeake Bay there is a succession of shoals and banks. Many of these are buoyed so that moderate-draft vessels may pass inside of them. In such a region it is important that the survey should be correct and up to date. At only one place has a comprehensive survey been made and this was the investigation of a reported shoal.

Chesapeake Bay and tributaries have been extensively surveyed in recent years and a large part of them will not require resurvey for many years. The parts which need resurvey are the deep portions from Cape Charles to a point opposite Annapolis, part of the James River, and the Rappahannock and Susquehanna Rivers.

The entrance has been recently surveyed but another survey will probably be needed in 10 years.

From Chesapeake Bay entrance to Cape Hatteras there are but few places where the shoals extend far from shore. The most pressing need is that the limits of these shoal areas be defined.

Diamond Shoals off Hatteras should be resurveyed to determine changes in their extent, and particularly to obtain a knowledge of the correct depths on the seaward side, so that vessels passing too close may be warned in time.

From Cape Hatteras to Winyah Bay, S. C., the changeable area along the coast is narrow and existing surveys of the adjoining area of moderate depth are sufficient. Two areas are exceptions, the Cape Lookout Shoals and the Frying Pan Shoals, to which the remarks made in regard to Diamond Shoals apply.

From Winyah Bay to Fernandina, Fla., the chief characteristic is the distance from the shore to the outer edge of the shoal banks



fringing it. Outside of these banks the water is fairly deep; this region has been recently surveyed.

From Fernandina to the Florida Reefs the area of moderate depths narrows until at Palm Beach the distance to the 100-fathom curve is very small. The completed survey extends southward to a little beyond St. Augustine. South of St. Augustine, the bottom is probably not subject to change except as noted below, and the surveys, while by no means complete, are fair. Off Cape Canaveral and outside the southern half of the Indian River there are extensive banks and ridges in urgent need of resurvey and which will require resurvey at intervals. Known depths of 11 to 16 feet a long way offshore show the need of further surveys to make certain that the shoals are correctly charted.

From Jupiter Inlet to Fowey Rocks the deep water approaches so close to the shore that it will be a slight task to do inshore work in connection with the offshore.

While many portions of the 10-foot route from New York to Beaufort have not been recently surveyed, so much of it is through canals and through the deeper portions of the bays and sounds that it is probably safe through most of its length. As soon, however, as the main route is left the defects of the charts become apparent.

The through route for launches following the coast is in need of resurvey for its entire length. The main routes are probably over permanent bottom through most of the way, but the number of soundings in many cases is not sufficient to show exactly where the most water can be obtained.

The various inlets from sea to these inland waters are subject to constant change; usually this change extends for some distance inside and outside of the inlet. These inlets are of such character that correct charts are impossible to maintain, except with frequent surveys. Entering inlets always involves a certain amount of unavoidable hazard, but as it has to be done and often under dangerous conditions, the charts should render all the assistance possible.

*Offshore waters, New York to the Florida reefs.*—From New York to Cape Hatteras the charts are only fairly good, by no means good enough to meet the full needs of navigation, but this work has been postponed, as the need for resurvey has been so much more urgent farther south. Up to a few years ago the offshore surveys from Cape Hatteras to the Florida Reefs were almost incredibly

deficient. This condition is being remedied as rapidly as possible and between Winyah Bay, S. C., and St. Augustine, Fla., the offshore work out to the Gulf Stream is complete.

It is important that this work be extended both north and south from its present limits as rapidly as possible. With adequate funds full advantage can be taken of the seasons, and by working in the north in the summer and south in the winter the cost of the work will be greatly reduced.

The method of locating a vessel by soundings requires accurate charts of the outside waters along all our coasts.

*Florida Reefs to Mexican border.*—We know that many uncharted rocks exist in the region of the Florida Reefs, but they are so numerous and the region is so large as to make it practically impossible to drag the entire area, both because of the time and cost involved. There is little navigation over the greater part of this area. Wire-drag work is accordingly recommended at present only where there is navigation or where maneuvering ground for naval vessels is required, involving localities not now used but likely to be useful when dragged. Even this minimum represents many years' work. Areas where the cost of wire-drag work is prohibitive must be resurveyed by other methods, which will result in finding many, though of course not all, of the uncharted rocks. Some areas are considered as completed even if not surveyed by the standard applied to the more navigated regions, and the present surveys meet all the present requirements.

Northward of the keys from Key West to Tortugas the doubtful area should be wire dragged. Florida Bay has an excellent survey, though coral heads are likely to exist here and there.

From Cape Sable to Apalachicola few additional inshore surveys are needed, as the existing surveys meet the needs of existing navigation well. Charlotte Harbor and Tampa Bay and their approaches need resurveys.

From Apalachee Bay to Cape San Blas the coast needs a resurvey and will need resurvey from time to time.

On the Florida and Alabama coast deep water approaches close to the shore and the inshore surveys are considered complete except in Pensacola and Mobile Bays. All entrances, however, require frequent resurveys.

The coast of Mississippi and Louisiana has a large proportion of changeable area; resurveys are needed now and will be needed from time to time from Mobile Bay to the end of the offshore

shoals south of Vermilion Bay. The immense load of sediment carried by the Mississippi River causes constant changes in the Delta.

Off the southern coast of Louisiana there is an extensive shoal region which is in need of survey.

The inshore waters along the rest of the Louisiana coast and the Texas coast, with an important exception, have deep water fairly close to the shore and no additional surveys are needed. The exception is along the eastern part of the Texas coast from Sabine Pass to Galveston.

Sabine Bank and Heald Bank have shoal depths at a considerable distance from the shore and they should have a thorough resurvey. Galveston Bay also needs resurvey.

Along the northern edge of the Straits of Florida the soundings are insufficient and they will have to be carried out somewhat beyond the 100-fathom curve.

The distance from the west coast of Florida to the 100-fathom curve is nearly 100 miles. Over much of this area the depths are moderate and the charts are based on reconnaissance surveys only. The bottom is coral rock in many places and projections may arise sufficiently near the surface to be dangers to navigation.

The 100-fathom curve approaches fairly close to the Mississippi Delta then swings offshore again so that it is about 60 miles south of Sabine Pass. It then swings to the southward in a curve which brings it within about 18 miles of shore at the Mexican border.

This whole offshore area is badly in need of a thorough resurvey and there is no other part of the work in offshore waters which is so likely to be productive in furnishing important changes in existing charts.

#### **Pacific Coast of the United States.**

Our western coast is generally mountainous, with few harbors, or inside waterways, and deep water close to the shore.

The purpose of surveys is to meet the needs of vessels approaching from seaward, and of coasting vessels and to insure up-to-date charts of the harbors.

Thick weather prevails much of the time and under these conditions the navigator must rely upon his chart. It is essential that detailed surveys be made to the 100-fathom curve.

From the western end of the Santa Barbara Channel to Monterey Bay the surveys as a rule extend only to the 50-fathom curve, which lies but a short distance offshore. These surveys

should be extended seaward to include the usual track of coast-wise vessels, which lies about 10 miles from shore.

San Francisco Bay is of varied character of bottom and the needed surveys vary to correspond. The outer approaches are complete except near the Farallones. Here additional soundings are needed and an investigation should be made with the wire drag.

The bar outside the Golden Gate needs a resurvey. Wire-drag work has been carried through Golden Gate and inside both northward and southward from San Francisco to the limits of the rocky area. The southern part of the bay where the bottom is subject to change needs resurvey.

From San Francisco Bay to Point Arena a widely spaced system of sounding lines has been carried out to the 100-fathom curve. Here an additional amount of work, about equal to that done, is required to complete the survey.

Between Point Arena and Cape Mendocino the surveys extend a uniform distance of 6 miles from shore, reaching depths varying from 50 to 200 fathoms. Additional detailed surveys should be made in the vicinity of each cape, and between them the work should be carried seaward to beyond the steamer track.

From Cape Mendocino northward to the Oregon boundary the limited surveys existing are old and inadequate. A complete resurvey should be made at once.

*Coast of Oregon.*—One word describes the condition on the Oregon coast—*unsurveyed*. A little work was done years ago south of Cape Blanco and near the Columbia River, but this does not extend out far enough to be of practical value to navigators. Elsewhere, no surveys have ever been undertaken.

*Coast of Washington.*—The statement just made regarding the Oregon coast is true of the Washington coast. The entire coast stands in urgent need of a first survey, except in the Strait of Juan de Fuca, where the present work is adequate. Willapa Bay and Grays Harbor have both been recently surveyed, but as both are of changeable bottom resurveys will be required.

### **Alaska.**

In Alaska waters scarcely enough work has been done to tell us how much remains to complete the charts. The development of the country has far outstripped the surveys, not only because of the few vessels and parties engaged in the work but because of the great length of coast and the intricate system of channels.

To appreciate the need of rapidly extending the surveys of these waters, it must be clearly understood that Alaska's only connection with the rest of the world is by water.

The amount of natural resources ripe for exploitation has been so great, and the prize they offered so tempting, that transportation could not wait for the Government to make the way safe. Transportation, therefore, went ahead and the Coast and Geodetic Survey, which should have been the pioneer, has followed impotently behind, charting dangers in many places more from reports of vessels wrecked on them than from data obtained from its own services. As this is written, the equipment of the Coast Survey for its essential work is smaller than it has been for years past and requests for sufficient means to continue the work have met with inadequate response. Even if the means were promptly given to provide the requisite ships and equipment, it will take years before the surveys can reach a point where they can meet the needs of commerce.

In southeastern Alaska the obvious need is to complete the wire-drag work. Most of these waters have been sounded; only dragging is necessary to complete this survey.

For some years past two parties have been actively engaged in dragging the main steamer route, and this work is a little more than half done.

The outside coast of the islands bordering on the open Pacific and their connecting channels are largely unsurveyed.

*Cross Sound to Prince William Sound.*—From Cross Sound, the northernmost channel from the inside waters to the sea, to Prince William Sound, there is need for surveys to insure the safety of vessels approaching and passing the shore. In this region the charts are very defective in the matter of soundings and the location of coastal mountain peaks and headlands that are a guide to the navigator.

*Prince William Sound to Unimak Pass.*—Prince William Sound needs additional soundings over most of its area and many of its branches need original survey. Wire-drag surveys are needed near Cape St. Elias and Middletown Island.

The approaches to Cordova have been surveyed but wire-drag work is needed to insure safety. This is also true of the approach to Seward.

Kodiak Island waters need additional surveys. From Kodiak Island to Unimak Pass but a small part has been surveyed at all.

*Aleutian Islands.*—The Aleutian Islands have little traffic and are without surveys except at Kiska Harbor.

*Bristol Bay.*—This is without survey except in Nushagak Bay and Kuskokwim Bay and River. The bottom is subject to change on account of the large rivers and additional surveys will be needed.

*Norton Sound.*—Additional surveys are needed throughout.

*Bering Sea and Arctic Ocean.*—Except in the vicinity of the Pribilof Islands and Port Clarence there are no other existing surveys in Bering Sea or to the north which are of value.

#### **Outlying Islands.**

*Porto Rico.*—The survey of this island was completed in 1910 except for wire-drag work. This is needed on the south and east coasts and around Culebra Island and in Virgin Passage. The Virgin Islands of the United States, lying just east of Porto Rico, are in need of original survey and wire-drag work in the harbor approaches. The surveys here needed would be in progress now but for the lack of boats staunch enough to work in rough waters under the trade winds.

*Guam.*—The present chart of the island of Guam is compiled from Spanish and British charts and some harbor surveys by the United States Navy. No attempt at a comprehensive survey has been made. A complete survey should be made of the harbors and the surrounding waters, carried out to a depth certain to include all dangers. In these waters shoals rise abruptly from great depths. The absence of soundings on charts does not mean safety but simply no surveys.

*Hawaiian Islands.*—There are only two good harbors in these islands, both on Oahu Island. All of the islands except Hawaii have coral reefs near them. In the vicinity of Oahu, Maui, Kahoolawe, and south coast of Molokai the surveys are fairly complete. Near Hawaii the surveys are very inadequate except in Hilo Bay. The west coast of Lanai and the vicinity of the two westernmost islands Kauai and Niihau are unsurveyed. The various channels between the islands from Maui to Oahu are fairly well surveyed; the others are practically without survey.

*Panama Canal approaches.*—The Atlantic approach to the Panama Canal has been surveyed since work started on the canal construction. In Limon Bay, however, pinnacle rocks occur and one of these was struck by the U. S. S. *South Carolina*. All the anchorages should be dragged and the work should be carried a short distance outside. The Pacific approach to the canal has had

a recent survey and has been dragged. No further surveys are now needed.

*Philippine Islands.*—The Philippine Islands are composed of not less than 3,000 islands and islets covering an area of approximately 115,000 square miles, about the same as that of the five New England States and the State of New York combined.

The total length of the general coast line is approximately 10,850 miles, or about the same as that for the entire Atlantic coast of the United States, including the islands. About 75 per cent of this shore line has been surveyed.

The unsurveyed hydrography covers a large area, on account of the necessity of extending this work, in some localities, for many miles offshore, and because of the extensive area of the Sulu Sea. About 50 per cent of this class of work has been completed.

The triangulation has been carried over the greater part of the coasts of the islands. There remain a few scattered places where only tertiary triangulation will be necessary, all of the secondary triangulation required having been completed. There is a connected system over the greater part of the coast and the adjustment to a uniform datum can proceed without interruption.

It is estimated that 64 per cent of the entire work of surveying the islands was completed at the close of the fiscal year 1917.

The unsurveyed regions are as follows:

The northeast coast of Luzon from Polillo Island northward to Aparri. The region off the north coast of Luzon, including the Babuyan Islands, Balintang Channel, the Batan Islands, and Bashi Channel.

The entire west coast of the island of Palawan and about one-half of the east coast of the same island.

The west coast of Mindanao, from Blanco Point, south to Zamboanga.

The south coast of Mindanao, from Pola Point to Malita, in Davao Gulf.

The Sulu Archipelago and the Sulu Sea from Cuyos, south to the limits of our possessions off Borneo.

#### **Geodetic Work.**

The situation in regard to the geodetic work in the United States can be summarized as follows:

The primary triangulation and the precise leveling which have been done are excellent in quality and form the basis from which

other primary triangulation and precise leveling may be extended. We should have as much more primary triangulation and precise leveling done in the near future as there is now in existence. It is the more necessary that this work be extended rapidly because of the great development going on in the industries and commerce of the country, especially in the extension of roads, railroads, river control, and other public works. Hundreds of millions of dollars are expended on roads alone each year in the United States. Each road that is built within an area not covered by a topographic map costs more than if a topographic map were ready. This applies to all extensive pieces of engineering work. In order that the topographic mapping of the country may be done accurately and economically, the primary triangulation and precise leveling should be rapidly extended into those areas which are yet to be mapped.

The lack of sufficient geodetic work in the form of primary triangulation and precise leveling is not due to negligence on the part of anyone, for it is only recently that engineers and surveyors have recognized the necessity for this geodetic control for maps and engineering work and have made heavy demands upon the Coast and Geodetic Survey to furnish it. With increased demand upon the Survey for this geodetic work it is naturally to be expected that funds will be provided to meet such needs.

The Survey realizes the necessity of publishing the results of its primary triangulation and precise leveling that they may be readily available for use. Material that is only in manuscript form is almost as valueless as if it did not exist. The members of the Survey who work in the division of geodesy at the office at Washington are almost exclusively engaged upon furnishing information principally to engineers and surveyors both in the Government bureaus and in private life. With increased activities in the field in extending primary triangulation and precise leveling there will be needed additional mathematicians and clerks in the office to compute and adjust the field observations and prepare the results for publication.

During the latter part of December, 1916, a number of letters were sent to the chief engineers of about 150 railroads of the country, asking whether mean sea-level datum is used by the roads or, if not, what datum is used for their elevations. The letter also asked whether the use of arbitrary datums by States, cities, counties, railroads, etc., was a detriment to the progress of the development of the territory traversed by the railroads.



Previous to sending out these letters to the chief engineers of railroads, circular letters embodying the same questions were sent to the chief engineers of a number of large cities of the country and to the engineer of each State. Many replies have been received and they indicate very clearly and very strongly that mean sea level should be universally adopted by all surveying and engineering organizations in the country using elevations in their work. In order that this may be practicable, it will be necessary to extend rapidly the precise level net of the country.

The observations with pendulums to determine the value of the intensity of gravity at places in the United States are largely of scientific value. The facts which this work develops are of great value to geologists and others in what may be called world science.

The subject is a new one and the Coast and Geodetic Survey expects to make many more observations with the pendulum and continue its investigations relating to the densities of the materials of the earth.

### **Magnetic Observations.**

While making magnetic observations was recognized a function of the Coast Survey at the time of its reorganization in 1843, it was not until 1899 that it became possible to undertake a systematic magnetic survey of the country. Up to 1877 the magnetic work was confined almost entirely to the Coast States, and was in most cases executed in conjunction with other branches of the Survey work. Some observations were made in the interior States in subsequent years, but the progress was very slow up to 1899.

The plan for the magnetic survey of the United States laid down in 1899 provided for a first general survey with stations 30 to 40 miles apart, to be followed by a more detailed investigation of regions where the general survey indicated irregular distribution of the earth's magnetism. The plan also included the reoccupation at intervals of about five years of a sufficient number of "repeat" stations to determine the change of the magnetic elements with lapse of time, and the operation of magnetic observatories for determining in more detail the changes in the direction and intensity of the earth's magnetic field.

Following this general plan, the distribution of stations has been based largely upon the county subdivision of the States, the idea being to have at least one magnetic station in each county, so that the necessary data might be available for the use of the county

surveyors in testing their compasses. With this end in view most of the stations have been marked in a permanent manner and the true bearings of prominent objects have been determined. In many cases meridian lines have been established for greater convenience of the local surveyors.

About 75 "repeat" stations a year have been occupied. Magnetic observatories have been in continuous operation at Cheltenham, Md., since 1901; at Sitka, Alaska, and near Honolulu, Hawaii, 1902; at Vieques, P. R., since 1905; at Baldwin, Kans., from 1900 to 1909; and near Tucson, Ariz., since 1909.

In Alaska the magnetic survey has gone on in conjunction with other work of the Bureau, so that the observations have been chiefly on the seacoast, with a string of stations along the Yukon River. A general magnetic survey of Porto Rico, Hawaii, and the Philippine Islands has been completed and some observations have been made in Guam and on the Canal Zone.

In the United States proper there remain many locally disturbed areas which require investigation, the extent to which this should be carried in any particular case being a question which can not be determined in advance. There are other regions where more stations will be required as they become settled. In order that the accumulated results may continue to be of use, observations at "repeat" stations must be made regularly.

It is important that the five magnetic observatories should be continued for many years, and that magnetic observatories should be established on the Canal Zone and on the Island of Guam.

### **Ocean Currents.**

No discussion of means designed to safeguard navigation is complete without considering the subject of currents, since it is to their unseen and unsuspected action that many disasters are due.

To this subject the Survey has devoted much attention. It publishes current tables for a number of localities, giving information of great value to the navigator. It hopes, however, to prosecute the observations and studies more vigorously in the future, so that the scope of the information so furnished can be expanded.

The first important step in this connection is the securing of hourly current observations at different lightships maintained by the Bureau of Lighthouses on the Atlantic, Gulf, and Pacific coasts to obtain data which would be basic for those localities. This is the more valuable because these lightships are stationed

near the tracks of marine commerce. However, before current observations at the lightships can be economically made it will be necessary to obtain legislative authority to expend funds for the moderate additional remuneration of the lightship crews while doing the work.

#### **Need for Vessels.**

Omitting the equipment for surveys in the Philippines, where vessels and funds are supplied in part by the Philippine Government, this Bureau has a fleet of only eight vessels for surveying the Atlantic and Pacific coasts and the Gulf shores of the continental United States, the waters of Alaska, Guam, Porto Rico, Hawaii, Virgin Islands, and the Panama Canal approaches. A description of these vessels, their condition and suitability for survey work is given elsewhere.

While for this enormous task eight vessels are available (six steamers, one barkentine, and one schooner), we shall find if we examine into the condition of these vessels that they are not the adequate equipment that even their small number would indicate. Just one of these ships, the *Surveyor*, is suitable for work in all kinds of weather. She is the best equipped of all, having been designed and constructed for the purpose. She can work in rough waters, endure the roughest seas, and has fuel capacity to enable her to remain at sea for a protracted period. Appendix D, attached to this report, gives in detail the facts concerning the vessels of the Coast Survey fleet.

Inadequate as they are for the enormous task imposed upon them, three of them—the *Surveyor*, the *Isis*, and the *Bache*—are, when this report is written, in the service of the Navy, helping to win the war.

Because of this inadequate equipment no concerted scheme of surveying work for our waters can be put into effect. We have to dissipate appropriations hither and yon, making detached surveys, often emergency surveys, as industry and commerce develop in one or other place and circumstances call for our aid. Since we are building, as this report is written, hundreds of vessels for our merchant marine, it is evident that the means provided for sea surveying are hopelessly outclassed and that at the time when these surveys are needed more than ever before in the country's history, the equipment for doing the work is least.

From the standpoint of insurance, the appropriations expended by this Bureau in providing nautical data for use in making nau-

tical charts is probably the least expensive of any Government venture. There were, during the past fiscal year, expended by this Bureau in making hydrographic surveys of our Atlantic, Pacific, and Alaskan coasts \$210,410 for field expenses, while over these waters during that period I am advised that excluding coast-wise trade \$8,089,314,107 in value of property was carried by water. There are many commercial activities in Alaskan and other waters awaiting the day when we can make the surveys and issue charts containing sufficient data to enable vessels to safely navigate those waters. But, until we have the adequate number of vessels and funds for carrying on this work, the full development of the country will be retarded.

#### **Government-Owned Launches Needed.**

Last year the Department urged an appropriation for the purchase of launches for this Bureau for use in wire-drag work and inshore surveys. This need still remains.

Because of the fact that there are no funds appropriated for the purchase of these power launches, they have been rented from private parties.

Past experience has shown conclusively that the rental which the Government must pay each season for chartered launches amounts to an average of one-fifth of their cost. In other words, 5 years rental would purchase the boats outright. As the average life of such launches is at least 10 years, the Government, by building its own boats, could get 10 years of service for 5 years rental.

Launch rentals are high for the following reasons:

1. Owners of launches that have never been used for wire-drag work are unfamiliar with conditions, and have no means of estimating the probable cost of repairs or deterioration.

2. The risk of loss or damage must be assumed by the owner, though he has no voice in the matter of how and when the launches will be used, and insurance rates are high, especially in Alaska.

Launches suitable for wire-drag work are scarce at any price for the following reasons:

1. Pleasure launches usually have enough power for the work but their hulls are too weak.

2. Fishing and working launches are generally of sturdy construction but are usually low-powered.

3. It is impracticable to use launches with two-cycle engines for wire-drag tenders, but launches of a suitable size equipped with four-cycle engines are few in number.

There is this further thing to be said about renting launches for wire-drag work. There are localities in which the wire-drag work must be done where launches can not be hired for the purpose because they are not there to be hired. This is true of the coral reef waters of Porto Rico. Likewise, the few launches available near Key West are wholly unsuited for wire-drag work. The launches used in the wire-drag work in southeast Alaska have all had to be transferred hundreds of miles from Seattle to their working grounds for none suitable for the work were locally available. (This subject is discussed more in detail in Appendix D.)

#### **Crews of Vessels.**

Another need in connection with the hydrographic work is to remedy the situation with regard to crews on the vessels of the Coast and Geodetic Survey, which has long been a serious one, and this year became so acute that a number of the vessels had to be laid up as a result of the impossibility of getting and keeping sufficient men to enable them to operate efficiently. This subject is treated at length in Appendix E.

As the matter now stands, however, not only are the vessels of the Coast Survey insufficient in numbers for the work and inadequate because of their condition, but it is not possible to use them all continuously because at the wages the service has been permitted to pay, men can not be had capable of doing the work well.

#### **Need for Higher Salaries for the Hydrographic and Geodetic Engineers.**

In the report for 1916 several tables and one diagram were shown, which contained data in regard to the compensation of the hydrographic and geodetic engineers of the Coast and Geodetic Survey, as compared with the compensation of other engineers in the Government service and in private life.

The appropriation for the fiscal year 1918 made a slight increase in the average compensation of the hydrographic and geodetic engineers but there is still the necessity for further increase in order that the positions may be made sufficiently attractive to draw young engineers and to hold them after they have been in the Survey a few years and have become familiar with our operations and methods.

**Office Needs.**

*Clerical force.*—The following are needed:

1. Increase in number of clerks.
2. Increase in entrance salary for clerks.

In the report of the Bureau for 1916 emphasis was laid on the fact that the work is greatly handicapped because of the lack of clerical help. It was also explained that though there are 40 clerks in the Bureau, so many are assigned to special duties that those really doing clerical work are but 25 in number. Conditions in this respect are as they were last year. The work of many divisions in the office is seriously handicapped because of the lack of clerical help. In some of the divisions, because this clerical work must be done, it has been necessary to assign other employees to it with the result that high-salaried technical employees are performing duties that a clerk at less salary could do better.

The entrance salary for clerks in this Bureau is \$720 per annum. There are six positions at this salary. From the fact that entrance salaries are higher in most other bureau and departments, a clerk that comes to this Bureau at \$720 per annum only remains long enough to qualify for a better-paying position in another bureau or department.

*Lithographic draftsmen and plate printers.*—Salaries for the printers in this Bureau are unusually low and we must obtain better salaries in order to retain competent men in the service. Our lithographic draftsmen receive only from \$1,200 to \$1,400, as compared to the \$1,380 to \$2,100 paid in the United States Geological Survey. Our lithographic transferrers are paid \$1,000 to \$1,200, while in the Geological Survey they receive up to \$1,920.

Plate printers in the Coast Survey are paid \$1,200 per annum. In the Bureau of Engraving and Printing they earn from \$3.07 to \$9.97 per day.

The great disparity between the salaries paid in this Bureau and the higher salaries paid in other technical bureaus has made our service a training school for other departments. They have drawn on us liberally. This is complimentary, but costly and discouraging.

*Instrument makers.*—The art of constructing and repairing instruments and apparatus used by geodesists, astronomers, and others engaged in the work of the Coast Survey is one requiring years of training, and at least elementary knowledge of mathematics, mechanics, physics, etc.

The work is never specialized, such apparatus never being produced in numbers. Each artisan, therefore, must be fully skilled in all branches of the profession.

The instrument makers of the Coast Survey have been much underpaid, as compared with employees in practically all the crafts short of mere factory hands and laborers in civil life, for many years prior to the present war. Under conditions now prevailing they can be expected to remain in their positions only as various private reasons prevent them from accepting better salaries elsewhere.

For several months past it has been impossible to fill a vacancy in our force of instrument makers at \$1,200 per annum.

*Need for additional draftsmen.*—In the last annual report of the Superintendent of this Bureau it was stated that the need of additional draftsmen is more pronounced than ever before. As no more draftsmen have since been provided, this statement is still true, but the situation is made worse by the accumulation of another year's results to be handled by an inadequate force already in arrears.

The impression that prevails to a large extent that when the field results are received in the office they need little more than fine penmanship to make them ready for publication is not correct. In most cases the plotting and verification of the results of a hydrographic survey requires as much time by an expert in the office as is required in the actual sounding in the field. In wire-drag surveys the office work consumes the more time. Nor is the field sheet, when completed, in a form suitable for publication. In fact, a chart contains the information compiled from a number of field sheets, both hydrographic and topographic. The selection of the proper soundings to adequately represent the under-water feature of the chart, to emphasize the important features on land, and to generalize the less important, is the work of an expert who has had years of training based on a thorough technical education. The lack of a sufficient number of draftsmen is one of the most serious hindrances to the prompt preparation of charts that the Survey now has to deal with, and it is essential that this situation be relieved as soon as possible.

*The need for an office building.*—By scrupulous care the officers of the Coast and Geodetic Survey maintain the buildings in which that service is inclosed (one can not truly say housed) in excellent physical and sanitary condition. The old structures are

not really worth the paint and the labor bestowed upon them. In good private or corporate practice they would have been sold to wreckers long ago. It is not necessary to repeat what has been said and illustrated so often before. Reference is made to page 156 of my report for 1915 and page 175 of my report for 1916, where illustrations and diagrams are found. Whatever is done upon these buildings to mitigate their unfitness for the use to which they are put is wasted upon them. Economy would get rid of them without delay. To house a business enterprise in such buildings would be a joke if it were not a tragedy. They stand directly across the street from the office building of the House of Representatives. There could not be a sharper contrast than between these structures which thus almost adjoin one another. If through some unhappy fate the Members of the House were obliged to walk once from top to bottom and between the unrelated group of structures which house the Coast and Geodetic Survey, further argument would be unnecessary. Good sense and sound judgment would come to the rescue and the waste arising from the use of structures wholly unfit for the purpose would speedily cease.

If the Commerce Building, for which land was purchased seven years ago, is soon to be built, the Coast and Geodetic Survey ought to be included in it in quarters specially designed for its particular work. If that building is not to be built, then a new structure on the present site, which is amply large for the purpose but not all used, should be provided at the earliest opportunity. It is sheer waste, and nothing other than waste, to keep the present structures in service.

Under date of January 10, 1917, the Surgeon General of the Public Health Service advised that Surgeon B. S. Warren had submitted a report from which the following is taken:

With the exception of the new printing division building, none of the buildings occupied by the Coast and Geodetic Survey are well adapted for the purposes for which they are now used. With the exception named, the buildings were originally constructed for dwelling and hotel purposes, and the arrangements are not at all suited to the requirements of the Coast and Geodetic Survey. A large number of the rooms are now so completely filled with desks, cases, racks, and the like, that there is scarcely room for the present occupants, and when the field officers come in to prepare their reports there is considerable overcrowding. It is difficult to see how the present cleaning force keeps the building in as good a condition as it was found. The improvement in the building since my last inspection is remarkable. There has been a general renovation of most of the building. The rooms have been painted, there have been new floor coverings, and much modern sanitary furniture has been installed. With all this, however, it is practically impossible to keep many parts of the building in proper condition owing to the nature of the building and the furniture demanded



in this kind of technical work. The special character of much of the work (that of drafting and engraving) requires an unusual character of light. The men engaged in this kind of work are necessarily subjected to an unusual use of their eyes, and their efficiency and output depend upon preventing unnecessary eye strain.

Attention is again invited to the lavatory facilities which, for the most part, are lacking throughout the building. As a result, there are a number of old-fashioned washstands, washbowls, and pitchers in common use throughout the building. It is hardly necessary to point out that such common use is a possible method of transmission of disease.

The only remedy for many of the existing conditions is to find a building suitable for this special character of work. For some time modern business men have realized that the efficiency and output of an establishment depends upon proper environment and are now spending large sums in this direction, and consider such expenditures "good business."

The progress of the work of the Coast and Geodetic Survey is greatly retarded by its unsuitable quarters. The condition remains unchanged except that it is growing worse as field records accumulate and office work increases in the effort to meet the larger demands placed upon it by a growing fleet and an increasing commerce.

A greater measure of protecting the valuable records of the Coast and Geodetic Survey against loss or damage by fire has been secured by the appropriation made in the act approved October 6, 1917, for \$12,000 for a sprinkler system. There is a question whether this may not substitute a minor water risk for a major fire risk, but, in the absence of an archives building, a fireproof vault, or a new building for the Coast and Geodetic Survey, or the Department of Commerce, in which the records can be securely kept, this seems the best thing available.

The printing facilities of the service have been greatly improved by the addition of another press with an offset attachment. This alone permits us to handle the large orders for charts from the Navy and from the growing merchant marine with something approaching adequate speed.

#### **General Summary of Operations—Vessels and Parties.**

*Atlantic coast.*—The steamer *Bache* was employed on offshore hydrography on the coast of Georgia, and on the approaches to the Savannah River; on revision work from Cape Henry to Sewall Point.

The steamer *Hydrographer* was engaged in surveys of the coast of the Delta of the Mississippi River; on resurvey of the inland waters from Lake Pontchartrain to Mississippi Sound and as far east as Pascagoula.

The steamer *Isis* was employed in offshore surveys on the coast of Florida, and on the approaches to Hampton Roads, Va. Both the *Isis* and *Bache* were laid up at Norfolk, Va., for several weeks before the close of the fiscal year, on account of lack of funds for field expenses.

The schooner *Matchless* completed the resurvey of the east side of Pamlico Sound from Ocracoke Inlet to the vicinity of Cape Hatteras; also a number of important tributaries to Albemarle Sound.

Wire-drag surveys were made of the northeasterly approach to Boston. Current observations and chart revision work were done in conjunction with the wire-drag work.

Wire-drag party No. 2 made surveys between Plymouth and Cape Cod Canal; in Block Island Sound in the vicinity of Montauk Point including Gardiners Bay; the revision of the survey of Fort Pond Bay was made. This party also made wire-drag surveys in the approaches to Narragansett and Buzzards Bays.

A comprehensive tide and current survey was made of Long Island Sound from Execution Rocks to New Haven.

A revision party covered the inshore hydrography from Norwalk Island to Block Rock Harbor, and from Eatons Neck to Oak Neck Point, including Huntington and Oyster Bays.

Revision surveys for the location of prominent natural objects and building and locating tall hydrographic signals were made on the coast of Georgia and Florida.

The field revision of the inside route pilot from New York to Key West was completed on July 13, 1917.

At the request of the Navy Department the speed trial course at Provincetown, Mass., was verified, the ranges shifted, and new beacons erected.

Suboffices were maintained at New York and Galveston, each in charge of an officer of the Survey. In addition to the usual work the officer at Galveston cooperated with the Steamboat-Inspection Service by examining seamen for certification in compliance with the seamen's act.

*Field work, Pacific coast.*—A shore party made a topographic resurvey of San Diego Bay. A comprehensive tide and current survey was made of Puget Sound south of Seattle. A revision was made of the triangulation, topography, and hydrography in the immediate vicinity of Seattle. A resurvey was made of the west side of San Francisco Bay; a wire-drag survey was also made of San Francisco Bay and the Golden Gate.

The triangulation and topography in the vicinity of Port Orchard, Wash., was revised.

Wire-drag party No. 3 made a survey in the vicinity of Puget Sound Naval Station and of the principal channels leading to it.

A field revision was made of the Pacific Coast Pilot. In the course of this revision a special study was made of the conditions affecting navigation along the coast of California, Oregon, and Washington.

Currents were observed in Richs Passage, Puget Sound, at the request of the Navy Department, and the submarine trial course at Port Townsend was verified.

*Field work, Alaska.*—The steamer *Patterson* was employed in southeast Alaska on the survey of the passages leading southward from Sumner Strait, the entrance to Cross Sound, and the outer coast of Chicagof Island.

The *Explorer* was on a comprehensive survey of the outer coast from Cape Muzon to Meares Passage, southeast Alaska.

The steamer *Taku* was engaged on surveys in Prince William Sound and tributaries, Alaska. On August 29, 1917, she was examined by the United States local inspectors of steam vessels, who reported fully upon her condition. In consequence of this report, the Bureau on September 29 recommended that the *Taku* be condemned and sold. This recommendation has been approved.

The steamer *Yukon* has been laid up at King Cove, Alaska, during the entire year for lack of officers and funds for field expenses and repairs.

Two wire-drag parties were employed in making wire-drag surveys in southeast Alaska. Wire-drag party No. 3 began work in Clarence Strait and carried the surveys to connect up with the previous year's work. Work was done in Eaton Sound and Kashevarof Passage was completed. Chicagof Pass and a part of Stikine Strait were surveyed.

Wire-drag party No. 4 worked in Sumner Strait, Clarence Strait, and along the channel between Mitkof Island and Zarembo Island to the entrance of Eastern Passage. Eastern Passage and Blake Channel were dragged and the work was extended through Bradfield Canal and the main channel of Ernest Sound to Point Peters on the south end of Deer Island.

*Field work, Philippine Islands.*—The work of the Survey in the Philippines is carried out under the direction of an officer of the

Coast and Geodetic Survey who, acting under the authority of the Superintendent, makes the plans for the works, issues the detailed instructions for the work to field parties, and also has charge of the suboffice at Manila.

There are five steamers at work on coast surveys in the Philippines.

The steamer *Pathfinder* was engaged on general surveys in the vicinity of Balabac and at Polillo Island.

The steamer *Fathomer* made surveys of the Busuanga Islands, the principal work being launch and ship hydrography.

The steamer *Romblon* was employed on surveys of the Cuyo Islands and at the south end of Palawan Island.

The steamer *Marinduque* continued, from last year, the surveys on the east coast of Palawan Island, including combined operations in Green Island Bay and vicinity. The inshore hydrography and the topography of Cambari Island and some topography on Dumaran Channel were finished. Several uncharted reefs and shoals were found in this locality.

*Assistance rendered in saving life or property.*—On August 17, 1916, the officers and crew of the steamer *Patterson*, C. G. Quillian commanding, assisted in reviving five men of the crew of the cannery tender *Mary Maloney*, who had been asphyxiated, presumably by gasoline fumes.

On October 21, 1916, the steamer *Marinduque*, A. M. Sobieralski commanding, took the small schooner *Florence* in tow at Araceli, Palawan. She was in distress with sails blown away, part of the rigging gone, and food and water low. Although the *Marinduque* was short of coal she towed the *Florence* to Coron and took the captain to Manila.

The rescue from drowning by a boat from the steamer *Bache*, Paul C. Whitney commanding, of a seaman who had fallen overboard from the British steamship *Kelvinbrae* is commended by the Department in a letter dated March 30, 1917. The rescue was accomplished at a time when it was very dark and in face of a high wind and strong flood tide.

On April 28 the steamer *Isis*, G. I. Rude commanding, bound up the St. Johns River, Fla., assisted in putting out a fire on the steam schooner *Rosalie Mahoney*, beached on the east side of the river. The *Isis* went alongside the *Rosalie Mahoney* and for three hours used her fire hose and crew to assist in getting the fire under control.

On February 18, 1917, a fire occurred on the water front in South Jacksonville at a lumber yard and ship-building plant. Before the fire was under control a launch from the *Isis* was sent over and towed the yacht *Soncy* to a safe berth.

*Coast pilot work.*—The collection of information in the field was carried out on both the Atlantic and Pacific coasts and in Alaska, and as a result of this field work two coast pilots, Alaska, Part I, Pacific Coast, California, Oregon, and Washington, and one inside route pilot, New York to Key West, were compiled.

*Tides and currents.*—Tidal observations were made throughout the year at seven permanent stations on the Atlantic coast, three on the Gulf coast, three on the Pacific coast, and one in Alaska; and in addition to this tidal observations were made in connection with all hydrographic surveys in the United States, Alaska, and the Philippines. Tidal indicators, showing automatically the stage and height of the tide, were maintained at Fort Hamilton, N. Y., and Reedy Island, Delaware River.

A special current survey was made of Richs Passage and the approaches to Bremerton Navy Yard, Puget Sound, Wash.

Two tide staffs were erected in Wrangell Strait, Alaska, for the benefit of navigators, and these were so arranged that the navigators can know directly the depth of water at the time.

A special effort has been made to have newspapers in the principal seacoast cities publish official tidal and related data, and a number of newspapers have published such data.

A new formula for taking account of the wind effect upon the observed currents has been devised and now in use. This makes it possible to further improve the current data and extend their practical uses.

*Geodetic work.*—A primary triangulation party operated on the Utah-Oregon arc which was completed in September. Upon its completion the party took up work on the arc from Utah to Needles, Cal.

Reconnaissance for triangulation was carried out from Las Vegas, N. Mex., to a point connecting with the oblique boundary between Nevada and California.

Primary triangulation was started in the vicinity of Little Rock, Ark., and carried westward into Oklahoma. This arc is to be continued westward to connect with the ninety-eighth meridian arc near El Reno.

A reconnoissance for primary triangulation was made between Oklahoma and California; also similar work was started on an arc to extend from Harlingen to Van Horne, Tex. The work on this arc was called for by the Chief of Engineers, United States Army, for the control of surveys for military maps needed for the War Department.

Some primary triangulation was done in Alaska on an arc which will eventually extend from Tacoma, Wash., to the intersection of the Yukon River and the one hundred and forty-first meridian, it being expected that the Geodetic Survey of Canada will do that part passing through Canadian territory. At the request of the War Department certain lines of primary traverse were run in Georgia and Florida for the control of surveys made by the United States Geological Survey for the purpose of furnishing military maps. The leveling over these lines was done by separate parties.

Tertiary triangulation was carried on in a number of localities during the year. Geographic positions were determined in San Francisco Bay and on the coast of California and in the vicinity of Charleston, S. C. The positions of a large number of wireless telegraph towers were determined on the Atlantic, Gulf, and Pacific coasts.

Astronomic work was done by the triangulation parties and also by the traverse parties.

A line of precise levels was completed from the vicinity of River Junction, Fla., to Mobile, Ala., by way of Atlanta and Birmingham. A second precise leveling party worked in Georgia during the last three months of the year on a line of levels extending from Brunswick toward Columbus by way of Macon. Another line was completed between Little Rock, Ark., and the Mississippi River opposite Memphis, Tenn. The line between Chicago and Jackson, Mich., was completed, as was also the line from Jackson to Mackinaw, Mich. In running these lines the best rate of progress was attained that has ever been reached by a precise leveling party in any country; a maximum of 159.6 miles of finished line in a single month.

Other lines of precise levels run were from Boundary to Vanceboro, Me.; from Clovis, N. Mex., to Pecos, Tex.; from Washington, D. C., to Indian Head, Md.; from Escanaba to Marquette, Mich.; from Marquette to Algonac, Mich. The total number of miles of precise levels run during the year was 2,930, which ex-

ceeds the amount done in any other year in the history of the Survey.

Astronomic longitudes were determined at a number of places in Oregon, Washington, Idaho, Utah, Nevada, and California.

The determination of the intensity of gravity was made at a number of places in California, Washington, Oregon, West Virginia, New Jersey, and Connecticut.

In all of the primary triangulation and reconnoissance therefor motor trucks were used as the means for transportation and which enabled the observers to utilize time for observing that formerly was expended in moving by teams from station to station.

*Magnetic work.*—During the year observations for the determination of the three magnetic elements were made at 319 stations distributed over 29 States. Of these stations 148 were primary, 120 auxiliary, and 40 repeat stations. There are now only 163 county seats in the United States where magnetic observations have not been made.

Observations were made (declination, or compass variation, only, in most cases) at a number of places in Alaska and in the Philippines in conjunction with other surveying operations.

The magnetic observatories at Cheltenham, Md.; Vieques, P. R.; Tucson, Ariz.; Sitka, Alaska; and Honolulu, Hawaii, were operated throughout the year.

The substitution of a small motor truck for a horse and wagon at the Tucson observatory has resulted in saving time and operating expenses.

## STEAMBOAT-INSPECTION SERVICE.

(GEORGE UHLER, *Supervising Inspector General.*)

The Steamboat-Inspection Service faces conditions unique in the history of the country. We are building ships at an unprecedented rate and these ships must be inspected, certificated, and furnished with licensed officers. As the following report shows, an enormous amount of work has already been done by inspectors of steam vessels in cooperation with various Government instrumentalities in connection with the work necessarily arising from the war. It is certain that these demands will increase in the passing months.

The weak spot in the Service remains the clerical staff. It was the weak spot last year. It is a weaker spot now. The addition of 31 inspectors during the current fiscal year did, indeed, add to the effectiveness of the force for vessel inspection. It also added seriously to the burdens of a clerical force that was already overworked and underpaid. It is too much to expect of human nature that, with increasingly onerous duties imposed upon a force already overworked, that force should assume even heavier duties in the future without increase in numbers or pay.

In answer to an inquiry from a gentleman who was much interested in the possibility of an increase in the salary of a clerk in one of the offices of the local inspectors, I wrote as follows on September 29, 1917:

With reference to the pay that clerks receive in the Steamboat-Inspection Service, it may be stated that the pay of all of them ought to be increased, because not only are they required to do a high order of work, but the amount of work that they have been doing for some time, and are doing now, as the result of the present war has materially increased the duties of all of the clerical men in the offices of the local inspectors.

My report of last year (1916) recommended on page 53 that the salary of the Supervising Inspector General of the Steamboat-Inspection Service be increased to compensate more nearly for the added duties that have been imposed upon this officer in recent years. It is now repeated that it would be an act of simple justice, after imposing these onerous duties, that his compensation should be made equal to that which others similarly situated



receive. The salary of the Supervising Inspector General of the Steamboat-Inspection Service should not be less than \$5,000. Formal request to this effect has been omitted from the estimates and the matter is here mentioned as one of justice that should be brought about as soon as conditions permit.

#### **Increase in Force.**

The duties of the Steamboat-Inspection Service have so increased that it now becomes necessary to substantially increase its inspection and clerical forces. Several years ago an inspection could be made in a comparatively short time. It now takes longer, because the standard of inspection has been raised and more detailed attention is necessary. This Service is continually being called upon to perform important work for other departments of the Government, such as inspecting hulls and boilers of Government vessels and boilers of Government buildings, and at this time it is assisting in every way possible the recruiting service of the United States Shipping Board in the work of obtaining men for the great merchant fleet now being provided. This fleet is being constructed as far as possible to meet the requirements of the rules and regulations of the Steamboat-Inspection Service, and it is understood that the ships will be certificated by this Service. It will be impossible for the present force of inspectors to properly perform this great work. This force has had no regular hours. Inspectors are often required to begin a day's work at 5 o'clock a. m., and can not conclude it until 10 or 11 o'clock at night. They have performed this work cheerfully, even though they are not paid salaries commensurate with such demands, but it is not right to expect the present force to take care of this great increased amount of work, and additional help should be promptly given them.

For some years the clerical force of the Steamboat-Inspection Service has been inadequate to take care of the work of the Service, and in many of the offices it has been found necessary to have assistant inspectors perform clerical work. This condition is due to the fact that sufficient appropriations have not been allowed the Service for clerk hire. The Service has not been able to secure the proper number of clerks, nor has it been able to pay adequate salaries to those clerks already in the Service. As a result, as soon as the clerks become proficient in their duties many of them, realizing the small chance of promotion, leave the Service to accept positions elsewhere at a larger salary. The work required of these clerks is of the highest order, the details being many.

They must be expert stenographers, capable of reporting important investigations and trials. They must familiarize themselves with the operations of the Steamboat-Inspection Service, as they often have to answer questions pertaining to the work of the Service during the absence of their superiors. They must also be able to take charge of the clerical work of the offices. New conditions are constantly arising since the work of the Service is continually expanding, which call for an increased clerical force to meet and handle the increased volume of work necessarily devolving upon it. An immense amount of work in connection with the inspection of the interned ships taken over by the United States Shipping Board fell upon the Service. The recruiting service of the Shipping Board, in its campaign for officers for the American merchant marine, is adding to its burdens, and, as the present plans of the Shipping Board for additional shipping are carried out, our entire force must necessarily be largely augmented to meet the emergency. A good spirit of cooperation to aid as much as possible has been shown, and the clerks are working much overtime, but aid is now required in the way of additional help. Congress has passed many laws relating to the Steamboat-Inspection Service and the merchant marine within recent years, such as the seamen's act, which have more than doubled the work of the Service, and particularly its clerical work, but Congress has increased its staff only in slight measure in comparison with the increased work and additional duties.

### Personnel.

The following positions were embraced in the Steamboat-Inspection Service at the close of business June 30, 1917:

#### At Washington, D. C.:

Supervising Inspector General.....	1
Chief clerk (who is Acting Supervising Inspector General in the absence of that officer).....	1
Clerks.....	8
Messenger.....	1
	<hr/> 11

#### In the Service at large:

Supervising inspectors.....	10
Traveling inspectors.....	2
Local inspectors of hulls.....	47
Local inspectors of boilers.....	47
Assistant inspectors of hulls.....	58
Assistant inspectors of boilers.....	58
Clerks to boards of local inspectors.....	69
	<hr/> 291
Total.....	302

Thirty-two permanent positions were added to the Service during the fiscal year, as follows:

One clerk in the office of the Supervising Inspector General, Washington, D. C.

One traveling inspector with headquarters at San Francisco, Cal.

One assistant inspector of hulls and one assistant inspector of boilers at each of the following ports: San Francisco, Cal.; Seattle, Wash.; Albany, N. Y.; Norfolk, Va.; Baltimore, Md.; Boston, Mass.; Providence, R. I.; Detroit, Mich.; Chicago, Ill.; Grand Haven, Mich., and New Orleans, La.

Two assistant inspectors of hulls and two assistant inspectors of boilers at Cleveland, Ohio, and Buffalo, N. Y.

#### **Summary of Activities and Statistics.**

Following is a summary of activities and statistics for the fiscal year 1917:

The force inspected and certificated 6,984 vessels with a total gross tonnage of 7,249,589, of which 6,776 were domestic vessels with a total gross tonnage of 5,960,310 and 208 were foreign passenger steam vessels with a total gross tonnage of 1,289,279. Of the domestic vessels, there were 5,530 steam vessels, 665 motor vessels, 21 passenger barges, and 560 seagoing barges. There was a decrease of 365 in the total number of vessels inspected and a decrease of 125,216 in the total gross tonnage of vessels inspected as compared with the previous fiscal year. Letters of approval of designs of boilers, engines, and other operating machinery were granted to 51 steam vessels with a total gross tonnage of 1,328. There were inspected for the Government 82 hulls and 1,590 boilers. There were 2,827 reinspections of passenger and ferry steamers, an increase of 86 over the previous fiscal year. The two traveling inspectors traveled over 17,666 miles, inspected 608 vessels, and found and reported 512 deficiencies of various kinds.

Licenses were issued to 26,962 officers of all grades. There were examined for visual defects 7,838 applicants for license, of whom 61 were found color blind or with other visual defects and rejected. Certificates of service were issued to 13,304 able seamen, and 1,507 were rejected. Certificates of efficiency were issued to 11,619 lifeboat men, and 2,943 were rejected.

Steel plates for the construction of marine boilers to the number of 3,609 were inspected at the mills, and a large amount of other

boiler material was inspected. There were examined and tested 202,583 new life preservers, of which number 1,359 were rejected.

The total number of accidents resulting in loss of life was 257. The total number of lives lost was 592, of which 71 were passengers. Of the lives lost 210 were from suicide, accidental drowning, and other causes beyond the power of the Service to prevent, leaving a loss of 382 lives as fairly chargeable to accidents, collisions, foundering, etc. There was a decrease of 684 in the number of lives lost as compared with the previous fiscal year. Passengers to the number of 317,095,171 were carried on vessels required by law to make report of the number of passengers carried. Dividing this number by 71, the total number of passengers lost, shows that 4,466,129 passengers were carried for each passenger lost.

#### **Adaptability to Changing Conditions.**

In such a vast country as this conditions are always changing and methods must change to meet them. To illustrate this spirit, reference is made to the conference on August 31, 1916, in the office of the Assistant Secretary. There were present several representatives of the leading steamship companies of the United States, who desired to take up with the Department the matter of the inspection of foreign-built vessels admitted to American registry, the inspection of which became due on September 4, 1916. It was apparent in the general discussion which took place that every endeavor was being made by the Department to meet in a businesslike way the problems that have presented themselves in regard to shipping, and the Executive order which was obtained as a result of the action of the Department, meeting the situation that presented itself, shows conclusively the spirit that has prevailed in meeting changing business conditions.

The same thing is true with reference to numerous other incidents of the same kind, which have been presented during the past fiscal year, that required not only prompt action but good constructive ability to adjust matters that affected not only the shipping interests but the entire public as well.

#### **Congestion of Work.**

For several years there has been a marked congestion in the inspection of vessels in the spring on the Great Lakes. In order to mitigate this condition to a certain extent, fall inspections of equipment were instituted on the Great Lakes, with the result that inspectors were able in a large measure to remove the cause

for congestion that occurred each spring. At the same time, however, that condition which makes it necessary to inspect a large number of vessels on the Great Lakes threatened to occur again during last spring, and it was given relief by the assistance of inspectors from the Atlantic coast. While this is an expensive procedure, and one not calculated to obtain the best administrative results, it was the only thing that the Department could do to meet the difficult situation, but it is to be hoped that the number of inspectors stationed on the Great Lakes will hereafter be able to take care of this work without detailing inspectors from other parts of the country to that vicinity. It is desirable that the inspectors on the Great Lakes should take care of this work themselves, because when men are taken from the Atlantic coast it results in congested conditions in the ports from which they have been taken, and efficient though they may be they are not, of course, as familiar with Lake conditions and Lake vessels as are men who have received their training on the Great Lakes.

The volume of work which made it necessary to send inspectors from the Atlantic coast to the Great Lakes also resulted in conditions in the offices, notably at Cleveland, Ohio, and at Buffalo, N. Y., which made it necessary to detail clerks to those boards. It is, of course, of no avail if the vessels are inspected and the inspectors are without the proper clerical assistance to issue the required certificates of inspection, licenses to men, etc., and therefore to meet this condition the Department not only sent clerks from other boards of local inspectors, but also detailed a man from the central office for that purpose. The work of the ninth district has been notably tied up as the result of insufficiency of force to do the work necessary by the fact that a large number of vessels are laid up in this district in the fall which require inspection in the spring. At Cleveland, Ohio, aside from the large number of vessels that are required to be inspected, it is also necessary that much testimony be taken for other boards of inspectors in connection with investigations and trials of licensed officers, and this is one great reason why the work in the Cleveland office has been behind, but as the result of special efforts which have been made in that office, as well as by the Department, the work is now in better condition than it has been for some time, and it is hoped that with a proper increase of force in both inspectors and clerks in the ninth district the conditions that have heretofore existed may cease.

**Division of First Steamboat-Inspection District.**

In two previous reports I have called attention to the absurd, not to say tragic, condition existing in the Steamboat-Inspection Service on the Pacific coast as a result of the present law. One supervising inspector is required by the statute to "watch over all parts of" and *visit* the local boards of inspectors in *all parts of the territory* between the Mexican border, the Arctic Ocean, the upper navigable portions of Snake River in Idaho, and the Hawaiian Islands. This territory is substantially 3,000 miles in dimension east and west and north and south. The area included in it is three times as great as that of the continental United States. No superman exists who can carry out the law under these conditions nor are funds sufficient to permit his doing so if he had the physical powers. Bills providing for the division of this district into two have been pending for several sessions. It is hoped that legislation may take place at the coming session which will end a condition which involves the very lack of the supervision which the law is supposed to prevent, and will provide liberally for the maintenance of this Service in the supervision of a coast line which even when divided will in the Alaska district be greater than that of the entire Atlantic and Pacific coasts of the country.

**Passengers on Ferryboats.**

Attention is again called to the fact that there is no legal limit to the number of passengers a ferry steamer may carry and, therefore, no power in the Department or in any Government service to prevent a ferryboat from carrying passengers in excess of a safe limit. The request of the Department that this be granted is renewed and emphasized.

**No Authority to Investigate Marine Disasters.**

It is again pointed out that there is no authority vested in the Department by law to investigate marine disasters but only to inquire into the conduct of licensed officers on such occasions.

It is believed to be the public impression that the Department can investigate disasters, apart from the conduct of the officers concerned therein. This is not the case. It ought to be the case and the requisite authority should be given. In Great Britain and in Canada such authority exists and it ought to exist here. As things are now such investigations as may take place on the part of the Department into marine disasters are only incidental to the inquiry into the conduct of the licensed officers.

In my last report I pointed out that the law gives the Department no jurisdiction over scows, their equipment or navigation, and expressed the hope that Congress would realize the necessity of providing for the protection of men employed on such vessels and would give us power of regulation in their behalf. To this should now be added a statement of the necessity of reducing the dangers to life and property on ocean tows in the winter season.

A bill was introduced, with the Department's approval, restricting these tows to not over two vessels from October 15 to March 15. Current practice is dangerous to life and property. The tows are heavier than the towboat can handle in severe weather and the cases in which life has been lost from this cause are numerous.

#### **Central Supervision.**

The Department has had in mind for some time the desirability of requiring local inspectors to furnish copies of all testimony adduced at investigations and trials, copies of certificates of inspection and of licenses, copies of blue prints of hulls, and copies of blue prints of boilers. While it may be said that all of this information is available in the offices of the respective boards of local inspectors, it is nevertheless a fact that many persons having business dealings with the Steamboat-Inspection Service naturally feel that they should be able to obtain any data in the office of the Supervising Inspector General at Washington. It would be in the interests of good administration to have these data at all times available, but it has not been possible to do so heretofore because there has not been sufficient clerical force either in the central office or in the field service. It is, of course, impossible at this time to undertake this work, for even were there a larger personnel in the offices of the Service, under the war conditions that now exist, it would not be practicable to do the work.

A vigorous follow-up system of all correspondence and reports is maintained, and has been found from experience to pay. An order that is given and that is not followed up may almost as well not have been given. While it is true that in nearly every instance orders are promptly obeyed, there have, nevertheless, been instances where there has been delay, or where matters have been overlooked; hence the necessity for a follow-up system.

The same principle has been followed in directing the work of the traveling inspectors. As complaints are received and referred to boards of local inspectors, they not only have to be approved

by the supervising inspector of the district, but as the traveling inspectors visit certain vicinities they also are required to look up the cases that are covered by the complaints and to approve them and return them to Washington.

### **Tests of Fire Extinguishers.**

It will be recalled that for many years there appeared in the editions of the General Rules and Regulations a long list of fire extinguishers that had been approved by the Board of Supervising Inspectors. Experience showed, however, that this list needed revising and it was accordingly revised. Samples of extinguishers were obtained from all the firms whose products had been listed by the Board of Supervising Inspectors, and these extinguishers were submitted to exhaustive tests by the Bureau of Standards. As the result, the list that appears now in the General Rules and Regulations is not as long as it was, but the Department believes that there is no name on that list now that should not be there. It was an immense undertaking to test all of the extinguishers that had been approved in past years by the Board of Supervising Inspectors, and in making these tests, and in deciding what extinguishers should appear on the list, the Department proceeded equitably toward those whose names had appeared. Some extinguishers it was necessary to take off the list at once, and these may not be used after the close of the present calendar year. Other extinguishers can be used in the opinion of the Board of Supervising Inspectors until December 31, 1919, but after that date their names will not again appear "approved," unless they have been tested again by the Bureau of Standards and found to meet in all respects the requirements. After January 1, 1920, all fire extinguishers must meet in all respects the tests of the Bureau of Standards.

### **Increase in Personnel.**

It matters not how excellently an officer may plan his work, or how rigorous the laws and General Rules and Regulations may be, good results can not be obtained if it is necessary that too much work be undertaken by too small a number of men. During the last fiscal year there were added 1 traveling inspector, whose headquarters are on the Pacific coast, 15 assistant inspectors of hulls, and 15 assistant inspectors of boilers. There was also added 1 clerk in the office of the Supervising Inspector General. Congress, in addition, provided for the creation of a board of local inspectors at Tampa, Fla.



The result of the appointment of the additional inspectors has been that more prompt service has been given to vessels and that more attention has been given to certain details of inspection. It is very natural that there should be an increase in the personnel of the Steamboat-Inspection Service, when one considers the expansion that is taking place in the American merchant marine. As these vessels are subject to inspection, it follows that there must be an increase in the number of inspectors and clerks. While Congress has given attention to the matter of increasing the number of inspectors, it has not provided for clerks to do the work in the offices of the local inspectors in the best manner. It is hoped that this feature of the work of this Service will not be overlooked by that body.

### **Overloading of Steamers.**

In connection with this subject one's mind logically turns to the problem of preventing the overloading of steamers carrying passengers. The Department believes that in a large measure that condition has been overcome, and in this connection it is to be pointed out that sections 4464, 4465, and 4466, Revised Statutes, have been substantially amended, so that there now rests upon the supervising inspectors of the respective districts the responsibility of approving the passenger allowance on vessels coming under their jurisdiction. This condition results in a check upon the action of the local inspectors who have original jurisdiction in the premises.

At the last meeting of the Board of Supervising Inspectors the matter of overloading passenger steamers received the attention of that body. The matter was thoroughly gone into, and each supervising inspector now understands what is required of him with reference to preventing unreasonable increase in passenger allowances.

In addition, stability tests may now be conducted by an expert detailed for that purpose, and during the past fiscal year several such tests have been made by that expert. Now in any instance where local inspectors are in doubt they promptly bring the matter to the attention of the authorities at Washington, and arrangements are made to have a stability test made.

Passenger steamers are, however, not the only class of vessels where attention must be given in the matter of overloading. It is to be recalled that at the present time there is no law against the overloading of freight steamers. Nevertheless, efforts were made during the fall of 1916, by detailing at certain special ports

on the Great Lakes inspectors whose business it was to watch this particular danger, and excellent results were obtained. The conditions that exist, however, leave much to be desired, and the one way to do this thing properly is to have a law enacted that will give the Steamboat-Inspection Service authority to say how deeply a vessel may be loaded. This will result not only in fairer conditions to the owners of vessels, but also to the inspectors, because inspectors under present conditions are entirely without authority, and can exercise at the most only strong moral suasion. It may be stated, however, that so far as overloading on the Great Lakes is concerned the owners cooperated with the Department, and much of the success that was obtained during the fall of 1916 was due to their cooperation.

### **Efficiency of the Service.**

When the Government declared war against the Imperial German Government, the Steamboat-Inspection Service was called upon to do things which taxed it to the utmost, and in the doing of these things the Service showed that it was prepared. As unusual demands were made upon inspectors, those demands were met by the inspectors, and this without any increase in the force. It must be evident that the Steamboat-Inspection Service could not have met the demands on it had not the small force worked overtime and given the best that was in them every day, on Sundays and on holidays.

Inspectors of this Service were detailed to the Cape Cod Canal to watch vessels navigating that body of water, and they accompanied vessels through the canal, and there was no untoward incident on that important body of water that stopped the traffic.

The Service was called upon by the United States Shipping Board to examine the interned German vessels, and when one remembers the damage which was done to those vessels it is easy to realize the magnitude of the task. This work was not only promptly undertaken but it was thoroughly done by the Steamboat-Inspection Service. The answer of the Service was not that it did not have men to do the work on top of its other work, but the Service did the work and submitted reports to the United States Shipping Board.

With our abundant resources for manufacturing iron and steel, and with our unlimited forests, the material for ships can be obtained, and with our splendid organization in the manufacture of iron and steel the finished product can be obtained in the way of plates for hulls and boilers, but men can not be obtained over-

night, or within a week or two. This is a great constructive problem which confronts the American people at this time. The inspectors of the Service have been busily engaged in cooperating with the recruiting service of the United States Shipping Board, in furnishing information with reference to the officers who are available to man the ships when they are ready, and they have also been approving the applications of persons who desire to enter the nautical schools that are being conducted by the recruiting service of the United States Shipping Board. While this has entailed an enormous amount of work in the offices of the local inspectors, both so far as inspectors and clerks are concerned, the Service has not suggested that it was impossible to undertake it. Its answer has been in this case, as in the case of interned vessels, that it has done the work. Reference is made to the matter in order that the fact may be pressed home that there must be more men furnished the Steamboat-Inspection Service or its work can not be kept up.

In connection with the mobilization of the resources of the United States in the present great conflict with the German Government, it is to be remembered that the great fleet of boats navigating the northwestern section of this country and the lower Lakes has been kept in motion, and the Steamboat-Inspection Service has had no small part in the work. It saw that the congested conditions existing on the Great Lakes with reference to the inspection of vessels were promptly relieved, though at great expense to the Service.

War conditions beget war measures to meet them, and there has been no more important work done by the executive committees of the Board of Supervising Inspectors than the new regulations that have been adopted with reference to obtaining licenses. Everything has been done that can be done to make it possible for competent applicants to obtain license. All over the country at the present moment, not only by the liberal features that have been embodied in the General Rules and Regulations prescribed by the Board of Supervising Inspectors, but also by the discretion that has in important instances been vested in local inspectors, men are now able, in a way as never before, to obtain license to service in the American merchant marine.

In my last report I mentioned that an inquiry by a committee of the Chamber of Commerce of the United States into conditions in the Steamboat-Inspection Service was progressing. The report has since been issued. It confirms the statement in the last report

to the effect that the laws under which the Service operates are archaic and should be revised. They are vague, unsuited to modern conditions, and in some respects contradictory. The authority thereunder is scattered and differences of practice are possible which make it impracticable to standardize the Service. The work is in better shape to-day than ever before; the force more adequate and effective. It can not, however, operate to best advantage without a marked increase in the clerical force, and in view of the great enlargement of our merchant marine now going on it will be necessary to add generously to the entire force of the Service. Otherwise the work is certain to fall behind.

The report of the Supervising Inspector General gives details of the year's work which are illuminating as to the variety of work required of the Service and its important character in protecting human life.

The work of the traveling inspectors has proven of great value. There has been a noticeable increase in the number of officers licensed during the year. The Service as a whole is on a higher basis than ever before, working with a more adequate force (except as to clerks) and with a better organization, with high and practical standards of service that have the approval of those most familiar with them.

Under the joint auspices of the Steamboat-Inspection Service and the Bureau of Navigation of this Department, a conference was held at the office of the Secretary on September 27, 1916, on the proposed establishment of load-line regulations. Details of persons attending and of the committee appointed to consider the question of bulkheads and load lines are given on page 21 of my report for 1916. The matter has since the conference and since the appointment of the aforesaid committee fallen within the scope of the United States Shipping Board, in whose care it normally lies under the present law. The proceedings of the conference were printed and are available to all interested in the matter.

The conferences on May 3, 1916, on the subject of making passenger vessels more secure from destruction by fire, and on May 22, 1916, on the subject of automatic sprinklers on vessels, also refers to matters that are now within the scope of the Shipping Board and will doubtless receive due consideration at their hands. The proceedings of both these conferences are also in print and are now available.

Reference is made to these conferences on pages 20 and 21 of my report for 1916.

## BUREAU OF NAVIGATION.

(E. T. CHAMBERLAIN, *Commissioner.*)

On pages 220 and 221 of the last report it was pointed out that Congress had imposed very heavy new duties upon the Commissioner of Navigation without allowing any additional force with which to do the work and without any added compensation to the Commissioner. It was then said and is now repeated that it would be an act of simple justice if after imposing onerous duties the compensation should be made equal to that which others similarly situated receive. The salary of the Commissioner of Navigation should be not less than \$5,000. Formal request to this effect has been omitted from the estimates and the matter is here mentioned as one of justice that should be brought about as soon as conditions permit. It should be remembered in this connection that the Navigation Service earns much more than its cost. In addition to the new duties imposed by law, as aforesaid, the great addition being made to our merchant marine means a further increase in the regular duties of the service for each ship must be admeasured and documented.

The salary of the chief clerk should be increased from \$2,000 to \$2,400.

### **Measurement of Vessels.**

The unprecedented increase in shipbuilding in the United States renders the accurate measurement of the tonnage of vessels building even more important than hitherto. At present, under laws administered by the Department of Commerce, employees of the Treasury Department at the customs ports measure vessels. Except at a very few ports, these men are primarily customs inspectors detailed as occasion requires to measure vessels. This system does not secure uniformity and accuracy of measurement, which is necessary. By cooperation with the Treasury Department it is hoped that at a later date a system devised to secure more satisfactory results may be put into operation.

### **Total American Merchant Marine.**

American merchant shipping registered for the foreign trade and enrolled and licensed for the coasting trade and fisheries on June

30, 1917, comprised 26,397 vessels of 8,871,037 gross tons, compared with 26,444 vessels of 8,469,649 gross tons on June 30, 1916, a gratifying increase. The following statement of the total of our tonnage at the close of each of the past fiscal years shows at a glance the changes in the total tonnage and what is even more interesting the change in the direction of its employment:

June 30—	Foreign trade.	Coasting trade.			Grand total.
		Great Lakes.	Sea and rivers.	Total.	
	<i>Gross tons.</i>	<i>Gross tons.</i>	<i>Gross tons.</i>	<i>Gross tons.</i>	<i>Gross tons.</i>
1914.....	1,076,152	2,882,922	3,969,614	6,852,536	7,928,688
1915.....	1,871,543	2,818,000	3,699,886	6,517,886	8,389,429
1916.....	2,191,715	2,760,815	3,517,119	6,277,934	8,469,649
1917.....	2,446,399	2,779,087	3,645,551	6,424,638	8,871,037

Since the outbreak of the war a steadily increasing proportion of our tonnage has engaged in foreign trade.

In order to provide the greatest possible freedom of movement for our commerce, the Department of Commerce united with the United States Shipping Board in recommending to Congress the passage of a bill permitting foreign ships to engage in the coasting trade during the war under conditions to be prescribed by the President. This measure became a law on October 6, 1917, and provides that the requisite permits shall be issued by the United States Shipping Board.

There has been a considerable increase in the output of American shipyards during the past fiscal year. It is not deemed wise, for obvious reasons, to publish the details but the facts are available to all who may be officially authorized to receive them.

By the act creating the United States Shipping Board and by the emergency appropriation acts the Federal Government with all its powers and resources has been placed in control of the shipbuilding industry with large sums at its disposal. The high prices of steel and labor and the desire to utilize our shipbuilding resources as fully as possible has led to a marked revival of wooden shipbuilding in this country.

Compared to the additions made to our merchant marine during the fiscal year, the total losses from all causes have been negligible.

Upon the declaration of war on April 6, 1917, it was found that the machinery on nearly all German ships in our harbors had

been more or less damaged. Proper steps were at once taken to make the necessary repairs and to put the vessels into service.

The act to prohibit the sale of American ships to foreign owners, except by consent of the United States Shipping Board, took effect upon the President's proclamation dated February 6, 1917.

The bill calling for the numbering of motor vessels to which reference was made on page 13 of my last report has passed the Senate and is now pending before the Merchant Marine and Fisheries Committee of the House of Representatives.

The act of October 3, 1917, providing revenue for war expenses, imposes a tax upon the use of yachts, pleasure boats, power boats, and sailing boats over 5 net tons, and upon motor boats of not over 5 net tons with fixed engines. This law makes it essential that some means be devised for recording those boats and procuring the names and addresses of the owners. The numbering bill would be a great advantage in this connection.

#### **Shipping Commissioners.**

During the year 506,941 officers and men have been shipped and discharged by shipping commissioners compared with 487,524 during the fiscal year 1916. In addition, collectors of customs acting as shipping commissioners shipped and discharged 18,439 officers and men, of whom 3,453 were shipped and discharged at Newport News. The estimates again provide for a shipping commissioner at that port at least during the war. The addition to our fleet will increase the amount of work of the shipping commissioners during the current year.

#### **Navigation Receipts.**

The receipts from tonnage duties during the fiscal year ended June 30, 1917, amounted to \$1,393,718.92 (including \$2,901.90 collected from the Philippine Islands' fund and \$6,022.10 alien and penal tonnage duties). The year's revenue from this source was \$60,846.91 less than during the previous fiscal year, when it was the largest for any year since the Civil War period, the falling off being in February, 1916. The amount is over \$70,000 in excess of that collected during 1915.

The receipts from navigation fees during the past year were \$159,808.03 compared with \$158,518.08 for 1916 and \$152,694.19 for 1914.

The receipts from navigation fines during the year amounted to \$49,962.37 compared with \$52,381.75. The current year probably will show a further decrease in the amount of fines collected,

inasmuch as the existing war conditions have rendered difficult compliance with the navigation laws in all respects and have necessitated lenient treatment of the offenses which have occurred largely because of such conditions.

From the three sources named during the fiscal year 1917 a total of \$1,603,489.32 was collected. The entire expenditures of the Bureau of Navigation were \$201,330.

### **Radio Communication.**

The work of the Bureau of Navigation in enforcing the two acts relating to radio communication and the London International Radio Telegraphic Convention of 1912, has been carried on throughout the year.

Special attention has been given to the equipment of vessels entering the war zones; 6,103 inspections were made on 12,139 clearances of vessels equipped with wireless apparatus, disclosing 502 cases where the equipment did not comply with the requirements of the law. Of these cases 143 were on American vessels and 278 were found on foreign vessels.

Considerable difficulty has been experienced in making these inspections, owing to the changes in the inspection force. All of the original inspectors in the field service voluntarily entered the service of the Army and Navy as reserve officers, necessitating the employment of new men unfamiliar with the duties. These men, however, are gradually being trained to the work and good results are expected during the coming year.

In addition to the work of inspection our field force, principally outside of office hours, is engaged in training radio operators and encouraging those already trained to enter the service of the merchant marine and the military establishments. There was fortunately a large reserve of amateur radio operators and from this source it is believed that the demand for skilled operators has practically been met. Between April 1 and June 30, the period from the time this country entered the war to the end of the fiscal year, 680 new commercial operators were secured. During the entire year there were 5,324 licenses issued to operators of all grades.

### **Enforcement of the Navigation Laws.**

The table following sets forth in detail by ports and laws violated the work of the Department in the enforcement of the navigation laws during the fiscal year 1917 and a comparison with previous years.



VIOLATIONS OF NAVIGATION LAWS REPORTED BY THE VARIOUS COLLECTORS OF CUSTOMS SHOWING THE LAWS VIOLATED, FISCAL YEAR ENDED JUNE 30, 1917, COMPARED WITH PREVIOUS YEARS.

Headquarters port.	Total.	Steamboat laws (R. S. 4397-4500).	Motor-boat law, "Rules of road."	Surrendered license (R. S. 4325-4326).	Bills of health (Feb. 15, 1893), <sup>a</sup>	Seamen's act (Mar. 4, 1915).	Anchorage and St. Marys River rules.	Passenger act (Aug. 2, 1882).	Enrollment and license (R. S. 4336).	Entry and clearance (R. S. 2774, 4197).	Name on vessel (R. S. 4176).	Change of master (R. S. 4335).	Unloading.	Radio communication laws.	Miscellaneous.
Baltimore.....	461	11	396	15	3			2		29	3	1	1		
Boston.....	427	171	155	50	9		13	5	3				2	5	14
Bridgeport.....	89	5	53	15		1							16		
Buffalo.....	87	36	50			1									
Charleston.....	50		14	21				1	6						8
Chicago.....	283	18	246	3	5			3	4	2					2
Cleveland.....	161	128	7	16	9							1			
Denver.....															
Des Moines.....	116		99	3					14						
Detroit.....	163	27	105	8	2			4	9	2	2	1	3		
Duluth.....	138	71	58	4	2			1			2				
Eagle Pass.....	1														1
El Paso.....															
Galveston.....	105	50	35	10				1	5	2					2
Great Falls.....							2	2					4	1	
Honolulu.....	18	1	6	2					6						
Indianapolis.....	54		47	1				1	2	4	1	1	1		2
Juneau.....	40	3	2	24				1			1	1			
Laredo.....	10	2	2	2				1			1	1			1
Los Angeles.....	137	3	95	25				4	7	1	1	1			
Louisville.....	128	7	102	10				1	8						
Memphis.....	84	21	33	17					9	1	3				
Milwaukee.....	82	29	40	1				1	8	1	2				
Mobile.....	109	15	18	47	2	1	2	3	4	2					15
New Orleans.....	315	45	147	71	4			4	28	2	4	4	6		
New York.....	1,292	97	1,049	60	5	5	12	1	47	2	4				10
Nogales.....															
Norfolk.....	430	47	328	18	1				20	1	1				14
Ogdensburg.....	74	2	45	24				1							1
Omaha.....															
Pembina.....															
Philadelphia.....	406	41	252	60	5	1			39	2	2	1	3		
Pittsburgh.....	4	3		1											
Port Arthur.....	93	53	7	20					9	1	1				2
Portland, Me.....	145	19	101	20	1				4						
Portland, Oreg.....	130	2	119	3	1			2	2	1					
Providence.....	94	10	65	6				1	1	8		1			2
Rochester.....	44	2	36					3	3						
St. Albans.....	68		68												
St. Louis.....	348	10	307	24			1		4	1	1				
St. Paul.....															
Salt Lake City.....															
San Francisco.....	196	33	70	22	5		6	5	6	17	2	4	4		22
San Juan.....	12	3	2	4				1							
Savannah.....	48	12	16	1	12				6						

<sup>a</sup> Bills-of-health cases transferred to Treasury Department, July 24, 1911.

VIOLATIONS OF NAVIGATION LAWS REPORTED BY THE VARIOUS COLLECTORS OF CUSTOMS SHOWING THE LAWS VIOLATED, FISCAL YEAR ENDED JUNE 30, 1917, COMPARED WITH PREVIOUS YEARS—Continued.

Headquarters port.	Total.	Steamboat laws (R. S. 4399-4500).	Motor-boat law. "Rules of road."	Surrendered license* (R. S. 4357-4356).	Bills of health (Feb. 15, 1893) <sup>a</sup>	Seamen's act (Mar. 4, 1915).	Anchorage and St. Marys River rules.	Passenger act (Aug. 2, 1882).	Enrollment and license (R. S. 4356).	Entry and clearance (R. S. 2774, 4197).	Name on vessel (R. S. 4178).	Change of master (R. S. 4335).	Unloading.	Radio communication laws.	Miscellaneous.
Seattle.....	318	16	138	100	27	192	5	5	14	4	6	2	1		
Tampa.....	547	24	134	56	192	2	55	5	6	73					
Wilmington, N. C.....	262	3	213	6	1	4	29	3	3						
Total—															
1917 (48 ports).....	47,569	1,020	4,660	770	286	29	42	43	400	41	74	22	182		
1916 (48 ports).....	47,825	812	5,126	943	271	1	19	59	331	35	67	43	90		
1915 (48 ports).....	46,868	671	4,462	982	11	10	104	41	348	67	93	37	42		
1914 (49 ports).....	46,720	768	4,838	631	8	25	41	26	153	59	90	36	45		
1913 (107 ports).....	3,506	333	2,783	23	23	8	24	10	83	26	1	40	152		
1912 (105 ports).....	3,634	165	3,119	96	3	12	17	38	81	12	.....	52			
1911 (92 ports).....	2,268	182	1,811	23	41	17	45	10	43	30	.....	50			
1910 (74 ports).....	1,070	252	488	17	52	13	61	13	68	12	2	76			
1909 (64 ports).....	1,134	151	710	33	69	3	21	14	7	59	4	63			
1908 (73 ports).....	852	245	385	12	42	6	21	23	18	30	7	2	61		
1907 (66 ports).....	684	209	92	88	36	18	62	9	52	27	5	63			
1906 (77 ports).....	670	194	130	114	41	13	27	0	49	5	9	72			
1905 (63 ports).....	524	142	53	99	42	13	21	26	7	20	11	28	62		
1904 (66 ports).....	706	184	93	101	48	49	16	29	12	24	19	(b)	131		

<sup>a</sup> Reports are now made by subports through the principal port of the district.

<sup>b</sup> Included under "Miscellaneous" in 1904 report.

The enforcement of the navigation laws during the fiscal year 1917 proceeded as usual although the work was somewhat affected by war conditions.

The facilities employed were the motor vessels *Dixie* and *Tarragon*, 56 navigation inspectors, 14 radio inspectors, customs officers, and the United States Coast Guard.

The table following shows the work of the various agencies of the Government employed in the enforcement of these laws.

VIOLATIONS OF THE NAVIGATION LAWS IN WHICH PENALTIES WERE IMPOSED AND  
SOURCES OF THE REPORTS FOR FISCAL YEAR ENDED JUNE 30, 1917.

Headquarters port.	Total.	Coast Guard.	Tarragon.	Dixie.	Local inspectors.	Radio inspectors.	Customs officers.	Navigation inspectors.	Cases reported under allotments.
Baltimore.....	469	5	185	119	7	.....	16	137	137
Boston.....	431	33	.....	103	181	5	109	.....	.....
Bridgeport.....	90	31	.....	24	3	.....	32	.....	.....
Buffalo.....	87	.....	.....	4	36	.....	1	46	46
Charleston.....	48	4	2	.....	.....	.....	42	.....	.....
Chicago.....	286	205	.....	.....	21	.....	24	36	36
Cleveland.....	173	3	.....	.....	132	.....	38	.....	.....
Denver.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Des Moines.....	109	67	.....	.....	.....	.....	42	.....	39
Detroit.....	173	112	.....	.....	30	.....	31	.....	.....
Duluth.....	133	.....	.....	.....	.....	.....	104	29	29
Eagle Pass.....	1	.....	.....	.....	.....	.....	1	.....	.....
El Paso.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Galveston.....	103	24	1	.....	2	.....	76	.....	.....
Great Falls.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Honolulu.....	20	.....	.....	.....	1	.....	19	.....	.....
Indianapolis.....	54	8	.....	.....	.....	.....	12	34	34
Juncos.....	41	9	.....	.....	3	.....	29	.....	.....
Laredo.....	10	2	.....	.....	.....	.....	8	.....	.....
Los Angeles.....	135	.....	.....	.....	1	.....	134	.....	102
Louisville.....	131	12	.....	.....	13	.....	62	44	44
Memphis.....	77	.....	.....	.....	18	.....	31	28	28
Milwaukee.....	84	48	.....	.....	27	.....	9	.....	.....
Mobile.....	109	5	17	.....	13	.....	74	.....	.....
New Orleans.....	314	33	124	.....	22	3	132	.....	.....
New York.....	1,291	252	554	235	71	.....	133	46	46
Nogales.....	1	.....	.....	.....	.....	.....	1	.....	.....
Norfolk.....	425	23	55	231	40	.....	39	37	37
Ogdensburg.....	72	.....	.....	.....	1	.....	71	.....	44
Omaha.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pembina.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Philadelphia.....	396	3	7	46	9	.....	187	144	144
Pittsburgh.....	4	.....	.....	.....	3	.....	1	.....	.....
Port Arthur.....	91	1	13	.....	7	.....	70	.....	.....
Portland, Me.....	145	7	.....	99	15	.....	24	.....	.....
Portland, Oreg.....	126	.....	.....	.....	1	.....	125	.....	118
Providence.....	95	22	.....	3	6	.....	22	42	42
Rochester.....	44	.....	.....	.....	.....	.....	44	.....	.....
St. Albans.....	68	.....	.....	.....	.....	.....	68	.....	68
St. Louis.....	334	80	.....	.....	10	.....	213	31	31
St. Paul.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Salt Lake City.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco.....	194	116	.....	.....	3	4	71	.....	8
San Juan.....	13	.....	.....	.....	.....	.....	13	.....	.....
Savannah.....	50	1	5	.....	10	.....	34	.....	.....
Seattle.....	329	90	.....	.....	12	1	226	.....	126
Tampa.....	549	15	79	.....	13	.....	442	.....	.....
Wilmington, N. C.....	260	44	192	.....	1	.....	23	.....	.....
Total—	.....	.....	.....	.....	.....	.....	.....	.....	.....
1917 (48 ports).....	7,565	1,255	1,234	864	712	13	2,833	654	1,159
1916 (48 ports).....	7,895	1,333	987	984	590	36	2,876	1,089	1,178
1915 (48 ports).....	6,860	1,380	1,425	.....	361	34	2,661	999	1,401
1914 (49 ports).....	6,720	922	1,762	.....	734	27	3,275	.....	1,325

The foregoing statement of the work done by the various inspection services is based on reports made by collectors of customs who report these violations to the Department for action and is approximately correct.

The Department has been gratified to find in its inspection work during the year a material improvement in the navigation of vessels as required by the navigation laws.

There were 812 violations in 1917 of the steamboat-inspection laws, an increase of 208 over last year, which is partly explained by the increase in vessels in the foreign trade and the increased demand for licensed officers and able seamen under the seamen's act of 1915.

The work of the service through its motor vessels in enforcing the navigation laws in a manner at once both vigorous and kindly but with a spirit which may, in the true sense, be called educational is bearing good fruit. An example is found in a report from the collector of customs for the port of Philadelphia, dated September 28, stating that from May 30 to September 3 of the present year but 77 boats were found violating the law out of a total of 1,333 inspections. Similar testimony is given from other districts after a period of careful law enforcement in those localities.

It would be difficult to give too much credit to the officers and men of the Navigation Service for the effective way in which they have enforced the laws during the past and previous fiscal years. The work has been thoroughly well done and without arousing any considerable antagonism, although the proceeds from mitigated funds have been such as to much more than cover the cost of the service. The officers and crews of the *Tarragon* and *Dixie* have done good constructive work by reason of which navigation along our coasts and especially in our protected waters is much safer than without their efforts it would have been. They have been very helpful in protecting the rights of seamen and have served the cause of humanity in more than one case where interference to preserve the sailor's rights was necessary.

The Department has received material assistance from various yacht owners who have tendered their vessels free and in some instances their own services in carrying out the motor-boat laws. Various associations of motor boat and yacht owners have also been very helpful in maintaining the standards of equipment

fixed by law and in cooperating to remove the necessity of constant detailed inspection. It is expected that this assistance from yacht associations will be extended in the future.

The motor vessel *Dixie* has been taken over by the Navy Department and is at present used as a dispatch boat.

The motor vessel *Kilkenny* was purchased on August 6, 1917, for \$8,700. The price was a very reasonable one and the Department deemed itself fortunate to secure so good a vessel at the figure. When the voucher for payment was sent it was returned by the former owner, Mr. Edward Crozer, with a note presenting the vessel to the Government with his compliments. Due acknowledgment was made of this generous and patriotic act. The *Kilkenny* is a motor boat of 52 gross and 45 net tons. She is 79.4 feet on the water line with a beam of 14.4 feet. The vessel is now undergoing the necessary alterations to fit her for the regular work of enforcing the navigation laws.

The motor vessel *Tarragon* continued her work during the year of inspecting motor boats and larger vessels, reporting during the year 1,234 violations of the law, which is nearly one-sixth of the total violations reported for that period from all points. In addition to her motor-boat work, this vessel assists in preventing the overcrowding of passenger vessels, enforces the rules of the road sees to the carrying of proper lights, etc.

#### Navigation Inspectors.

The Department has continued the work of preventing the overcrowding of passenger vessels throughout the year with results shown by the following table:

NUMBER OF COUNTS AND THE NUMBER OF PASSENGERS INVOLVED IN PREVENTING OVERCROWDING OF PASSENGER VESSELS DURING FISCAL YEAR ENDED JUNE 30, 1917.

Port.	Navigation.		Customs.		Total.	
	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.
Baltimore.....	1,719	838,469	5	1,733	1,724	840,202
Boston.....	2	2,154	875	648,744	877	650,898
Bridgeport.....			5	3,861	5	3,861
Buffalo.....			3,023	829,053	3,023	829,053
Charleston, S. C.....			26	11,218	26	11,218
Chicago.....	897	269,633	127	45,425	1,024	315,058
Cleveland.....	1,376	259,534	389	318,960	1,765	578,494
Detroit.....	674	891,171	69	87,990	743	979,161
Des Moines.....			1	1,242	1	1,242
Duluth.....	87	15,616	143	43,998	229	59,614

NUMBER OF COUNTS AND THE NUMBER OF PASSENGERS INVOLVED IN PREVENTING  
OVERCROWDING OF PASSENGER VESSELS DURING FISCAL YEAR ENDED JUNE 30,  
1917—Continued.

Port.	Navigation.		Customs.		Total.	
	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.
Galveston.....			90	6,935	90	6,935
Indianapolis.....	128	41,010	2	854	130	41,864
Louisville.....	158	36,838	119	59,442	277	96,280
Memphis.....	177	63,916	4	2,515	181	66,431
Mobile.....			10	2,342	10	2,342
New Orleans.....			3	1,132	3	1,132
Norfolk.....	68	22,667	28	10,090	96	32,757
Ogdensburg.....			33	12,686	33	12,686
Philadelphia.....	242	151,998	71	34,724	313	186,722
Port Arthur.....			31	307	31	307
Portland, Me.....	487	73,318	1	112	488	73,430
Portland, Oreg.....			14	2,388	14	2,388
Providence.....	607	282,975	38	9,563	645	292,538
St. Albans.....			46	17,987	46	17,987
Seattle.....			182	69,303	182	69,303
Tampa.....			2	445	2	445
Total.....	6,622	2,949,299	5,336	2,223,049	11,958	5,172,348
Total for fiscal year 1916.....	8,359	3,244,953	5,451	1,867,814	13,810	5,114,351

The above totals do not include the report from New York which shows a total number of counts for the fiscal year of 3,608, the number of passengers involved being 1,624,093.

It is the uniform practice of this Department to prevent the overcrowding of passenger vessels rather than to permit them to violate the law and then impose penalties for so doing. The following table shows the cases (called shut-offs) in which inspectors have been obliged to stop vessels from loading to excess above the legal limit arranged by months and customs districts.

## SHUT-OFFS, BY MONTHS, DURING THE FISCAL YEAR ENDED JUNE 30, 1917.

Port.	July.		August.		September.		November.		December.	
	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.
Baltimore.....	28	23,326	6	4,750	3	3,050	1	500		
Boston.....			17	15,083	4	1,856				
Buffalo.....	2	1,300								
Charleston.....	1	300								
Chicago.....	71	30,898	24	8,066	1	202				
Cleveland.....	40	36,156	17	12,611	2	1,915				
Detroit.....	22	50,883	11	26,568						
Duluth.....	5	3,196								
Indianapolis.....	1	900								
Louisville.....	2	625	1	356						
Memphis.....	1	600			1	272				
Norfolk.....	2	986	6	3,011	1	416				
Ogdensburg.....	2	700								
Philadelphia.....	1	1,189								
Portland, Me.....	1	400	4	802						
Providence.....	8	4,394	15	13,202	3	4,610				
Rochester.....	1	670								
Seattle.....	11	3,685			1	280				
Tampa.....									1	230
Total.....	199	160,108	101	84,449	16	12,601	1	500	1	230

Port.	March.		May.		June.		Total.	
	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.
Baltimore.....	2	1,538			2	2,384	42	35,448
Boston.....							21	16,939
Buffalo.....							2	1,300
Charleston.....							1	300
Chicago.....					3	616	99	39,782
Cleveland.....							59	50,682
Detroit.....					1	1,800	34	79,251
Duluth.....							5	3,196
Indianapolis.....							1	900
Louisville.....					1	356	4	1,337
Memphis.....					1	1,000	3	1,872
Norfolk.....							9	4,413
Ogdensburg.....							2	700
Philadelphia.....							1	1,189
Portland, Me.....							5	1,208
Providence.....							26	22,206
Rochester.....							1	670
Seattle.....							12	3,963
Tampa.....							1	230
St. Albans.....			1	725			1	725
Galveston.....			2	710			2	710
Total.....	2	1,538	3	1,435	8	6,156	331	267,017

NOTE.—The above totals do not include the report from New York which shows that during the fiscal year 22,144 intending passengers were shut-off on a total of 82 trips.

From this table it will be noted that on 331 occasions, involving the safety of 267,017 passengers, our men prevented the overloading of vessels. For nearly three years we have been training these inspectors and have now established a corps of active and efficient men who have done much to increase the safety of the excursion business on the water.



### **CONCLUSION.**

The foregoing is respectfully commended to your attention and to that of Congress.

Respectfully,

**WILLIAM C. REDFIELD,**

*Secretary.*

## APPENDIXES.

### Appendix A.—\$5 PER DIEM REQUIREMENT.

For two years past the attention of Congress has been invited to the injustice often suffered by employees of the Department of Commerce as a result of the limits imposed by law upon subsistence expenses of employees traveling away from their posts of duty on official business of the Department. Under the law as it now stands, such employees can charge only actual necessary subsistence expenses at a rate not to exceed \$5 a day (act of Apr. 6, 1914, 38 Stat., 318), or they may receive, upon proper authorization by the head of the department, a per diem allowance in lieu of subsistence at a rate not to exceed \$4 a day (act of Aug. 1, 1914, 38 Stat., 680).

In many cases the limits fixed by the two laws above cited provide sufficient leeway to enable traveling employees to receive complete reimbursement for all their subsistence expenses. The fact, however, that the limit is fixed by law and no discretion is left in the head of the department works an injustice to employees who travel in places where subsistence expenses are unusually high and where they are thus compelled, since they are under orders to perform service at those places, to pay a portion of the Government's legitimate expense out of their own pockets.

This condition, burdensome in the past, has now become almost intolerable. Everyone knows that the war has increased living expenses, and the Comptroller of the Treasury has decided that the costs of laundering and pressing clothes are subsistence items and must be included within the above-named limits. In many cases employees of the Department visiting the large cities of the country must live in such a place and in such a manner as to be reasonably representative, without extravagance, of the Government they serve. There are times, under present conditions, when adequate accommodations can not be had in our larger cities, for a short stay, which shall include board, lodging, laundry, and the care of clothing, within \$5 per day.

Employees of the Department traveling abroad, especially in Central and South America, meet even more difficult conditions with reference to living costs than do those traveling in the continental United States. It is not possible, at the present time, for traveling employees, either in Europe or South America, to live in even reasonably comfortable hotels for less than \$7 per day. This results, from the necessities of the case, in employees paying from their own pockets the difference between their actual living expenses and the amount allowed by the Government.

The opposite alternative of living for short periods in cheap boarding houses means in many countries a definite loss of consideration and of effective service to the Government. On the other hand, employees who pay out of modest compensation a considerable part of the cost of their living in places where they are sent under Government orders, naturally feel the injustice of such a condition. In these cases efficiency is reduced because an employee often can not afford to stay long under such conditions and hastens his work at the cost of thoroughness.

It is, of course, true that there are many circumstances, particularly in this country, where conditions under the existing law are provided for satisfactorily. It is not desired to alter these conditions nor the practice which applies to them but merely to stop the injustice of compelling employees to assume on Government behalf a large part of the cost of the work that Government orders them to do.

This matter is not complete without a reference to Alaska, for there conditions are, perhaps, even more onerous than elsewhere. The distances are great. The expenses are high. The employees are paid but modest salaries. They must travel—they have no choice in the matter—but they can not travel unless they pay many of their own traveling expenses in addition to the regular cost of maintaining their homes. Previous reports have shown the actual losses incurred by employees under these circumstances.

Both the laws referred to were passed in 1914. Since that time conditions have changed. Living costs have greatly increased, and even if it be assumed that at the time these laws were passed the limits imposed by them were sufficient, they are often inadequate at present. The \$5 limit for actual subsistence expenses and the \$4 limit for per diem in lieu of subsistence have been in force in the Government service for perhaps 25 years. When first established they easily covered the subsistence expenses of traveling employees. The theory upon which they were established at that time was correct, and the amounts fixed were reasonable; to-day they are far from reasonable and should be changed to make them correspond to present conditions.

I recommend, therefore, the substitution for the two legislative provisions mentioned of a provision imposing upon the head of each department and independent establishment the duty and authority to fix the rates at which traveling employees can be reimbursed for their actual necessary subsistence expenses or can be given a per diem allowance in lieu of subsistence. It is respectfully pointed out that conditions in different localities are not and can not be alike at any one time and that no law imposing a fixed rate can ever be made to meet the conditions of all cases. Furthermore, these conditions change and sometimes change very rapidly. It costs more to-day than it did to travel in the United States, but our domestic conditions in this respect are as nothing compared to the great increase in the cost of traveling in Russia under existing conditions. As a matter of fact, conditions in Russia have become so costly that it has been found necessary to withdraw men from that field.

If in the judgment of Congress some fixed limit must be imposed, it is suggested that existing laws be so amended as to alter the limit for actual necessary subsistence expenses for employees traveling in the continental United States, exclusive of Alaska, from \$5 a day to \$7 a day, and the limit for per diem in lieu of subsistence for such employees from \$4 to \$5 a day, and to increase the corresponding limits for employees traveling in foreign countries or in Alaska or the insular possessions of the United States to \$8 and \$6 a day, respectively.

## Appendix B.—PROMOTIONS IN THE BUREAU OF THE CENSUS.

As explained in my last two reports, the Census Bureau labors under a great handicap by reason of its low average salary scale, which is causing many members of its force, including some of the most capable ones, to leave for more lucrative employment elsewhere, both within and without the Government service. The extent of this handicap will be more readily understood and its seriousness will be more thoroughly appreciated when it is stated that out of the 563 official, clerical, and sub-clerical positions on the statutory roll of the Bureau, only 98, or 17.4 per cent, pay salaries in excess of \$1,200 per annum, whereas in the other bureaus of the Department, considered as a whole, 39.9 per cent of the positions pay salaries higher than that figure. Furthermore, in 1912 (the latest year for which data are available) 36.1 per cent of the positions in all the Executive departments combined, exclusive of those in the Bureau of the Census, carried rates of compensation greater than \$1,200 per annum. That is to say, the proportion of the Census force which receives more than \$1,200 per annum is less than half as great as the corresponding proportion for the remainder of the Department of Commerce and is also less than half as great as was the corresponding proportion in the remaining bureaus of all the departments combined five years ago.

The natural and inevitable result of this state of affairs appears in the fact that during the period from July 1, 1916, to September 30, 1917, the Census Bureau lost no fewer than 89 officials and employees, or nearly 16 per cent of its entire statutory force. The following cases are cited to illustrate the difference between the salaries received from the Census Bureau by some of the members of its force who have left since July 1, 1916, and the salaries they are now receiving:

Position.	Salary.	Salary in present position.	Position.	Salary.	Salary in present position.
1 chief statistician.....	\$3,000	\$4,500	2 clerks.....	\$1,000	\$1,200
1 chief of division.....	2,000	4,000	6 clerks.....	900	1,600(1)
1 clerk.....	1,800	3,000	1 skilled laborer.....	900	1,200(5)
2 clerks.....	1,400	1,600			1,800
4 clerks.....	1,200	2,000(1)			
		1,600(2)			
		1,400(2)			

It should be obvious that an official or employee is worth more in the office in which he has had years of training than in one in which he has had no experience whatever; yet, as will be seen from the foregoing table, one of the officials who left the Bureau is now drawing double the salary paid him here, and the other official and a number of the clerks who left are receiving greatly increased compensation.

In this connection it may be mentioned that in its estimates of appropriations for the fiscal year 1915 the Census Bureau asked for a reclassification of its force, but no action was taken upon its request.

For the fiscal year 1917 Congress granted, at the request of the Bureau, an increase of 1 in the number of chiefs of division on its roll and increases of 4 positions in the \$1,800 class, 5 in the \$1,600 class, and 3 in the \$1,400 class, together with a decrease of 13 in the \$1,200 class. These changes, however, gave the Bureau only slight relief,

since the number of \$1,200 positions on its roll still remained inordinately large and the number of positions above \$1,200 inordinately small in proportion to the total.

For the fiscal year 1918 the Bureau requested increases aggregating 33 in the number of positions at salaries above \$1,200, together with a corresponding decrease of 33 in the number at \$1,200. This would have necessitated an increase of only \$9,600, or less than 1½ per cent, in the total appropriation for salaries, but would have made possible a considerable number of well-deserved promotions. This increase, however, was not granted, and as a result the Bureau lost during the year a large number of its trained and capable officials and employees.

Not only is the Bureau thus handicapped by its exceedingly low salary scale, but it suffers by reason of the inadequate size of its force. The following table shows the total statutory force of the Bureau and the number of clerical positions in each salary class, by fiscal years, beginning with the close of the last decennial census period:

Fiscal year—	Total force, <sup>a</sup>	Clerks at—					
		\$1,800.	\$1,600.	\$1,400.	\$1,200.	\$1,000.	\$900.
1912-13.....	610	11	20	32	300	83	87
1913-14.....	621	11	20	39	305	83	86
1914-15.....	589	11	20	38	303	83	85
1915-16.....	569	11	20	37	300	83	82
1916-17.....	562	15	25	40	283	83	81
1917-18.....	563	15	25	40	283	83	81

<sup>a</sup> Includes official and subclerical positions.

It will thus be seen that the Bureau's force is smaller by 47 than it was 5 years ago. Moreover, it is smaller by 73 than it was during the fiscal year 1907-8, which bore the same relation to the Thirteenth Census period that the present fiscal year bears to the Fourteenth Census period. A portion of this reduction (39 employees) was due to the removal of the Census Bureau to the Commerce Building and the resultant consolidation of a part of its force with that of the Department; but, making allowance for this consolidation, it is now operating with 34 fewer employees than it had 10 years ago. Its work, however, is materially greater at present than it was at that time, to some extent by reason of the addition, in 1912, of the semiannual (now quarterly) tobacco inquiry to the investigations regularly carried on by the Bureau, but more especially because of the general increase in the work along all lines, due in part to the growth of the country during the past decade and in part to the amplification and extension of certain inquiries, such as those relating to births, to mortality, to cotton and cottonseed, and to cities and States.

The increase in the vital-statistics work is worthy of particular mention. This work is rapidly becoming greater from year to year, not merely by reason of the increase in the population of the country but also because of the extension of the "registration areas" for births and deaths. The collection of birth statistics by the Census Bureau was begun only a few years ago, but already the birth-registration area comprises 13 States and the District of Columbia and contains more than a third of the population of the country. Tests are being made in six other States to determine how closely their birth registration approaches completeness, and as a result of these tests it is likely that the records of some of these States also will be accepted in the near future. The death statistics, which 10 years ago related to less than one-half, now pertain to approximately 70 per cent, of the population of the United States, distributed throughout 26 States, 46 cities in other States, and the District of Columbia. The growth of the vital-statistics work has been so great as to necessitate the employment during a portion of each year of about 30 additional operators of tabulating machinery.

The work of the division of cotton and tobacco statistics has been greatly increased as a result of recent legislation. The act of August 7, 1916, authorized the Census Bureau to collect and publish (a) quarterly statistics relating to the consumption of bleached cotton fiber in the manufacture of explosives; (b) quarterly statistics as to the consumption of unbleached cotton fiber in the manufacture of absorbent and medicated cotton; and (c) monthly statistics pertaining to cotton seed received, crushed, and on hand, and to cottonseed products manufactured, shipped out, and on hand.

The act of May 10, 1916, required the Census Bureau to collect and publish quarterly statistics relating to stocks of leaf tobacco held by manufacturers and dealers, classified according to principal types. This work had formerly been done at semi-annual, instead of quarterly, intervals, under the terms of the act of April 30, 1912.

A further need for the enlargement of the Bureau's force is found in the fact that during the coming fiscal year—whose termination marks the beginning of the Fourteenth Census period (July 1, 1919)—it will be absolutely necessary, if that census is to be taken properly, to do a great deal of preparatory work for it.

The division of agriculture, which went temporarily out of existence at the close of the Thirteenth Census period, has recently been reestablished. The force of this division, however, at present comprises only one official and six employees. A great deal of work must be done in preparation for the Fourteenth Census, and all comparative tables to be printed in the reports should be prepared, so far as figures for the Thirteenth and preceding censuses are concerned, before the beginning of the Fourteenth Census period, or at least before the enumeration is made. This can not be done, however, unless a very much larger force is provided for the division.

Much work is necessary in preparing for the decennial census of mines, quarries, and oil and gas wells, and should be commenced at the beginning of the next fiscal year. As no work on this inquiry has been done since the publication of the Thirteenth Census report on mines and quarries, the services of a number of employees will be needed to make suitable preparations for this branch of the Fourteenth Census.

The geographer's division, whose duties include the establishment of supervisors' and enumerators' districts for the decennial censuses, must begin this work, in preparation for the Fourteenth Census, early in the coming fiscal year. The magnitude of this task will be evident when it is stated that the number of enumerators' districts at the next census will be approximately 75,000.

The divisions of population and manufactures will also need more clerks for preliminary Fourteenth Census work, although, by reason of the fact that these divisions have been in continuous existence since the Thirteenth Census, they will not need as many as the division of agriculture.

In making its estimates of appropriations for the coming fiscal year, therefore, the Census Bureau will ask for an increase of 79 in its statutory force, in order that it may be enabled, first, to take care of the increases in its current work, especially in vital statistics and cotton and tobacco statistics, and second, to make proper preparations for the Fourteenth Census. With the view of readjusting its salary scale so as to bring it more nearly into conformity with the salary scales prevailing elsewhere in the Government service, 56 of the positions needed for the next fiscal year have been estimated for at salaries in excess of \$1,200; and the estimates also call for a reduction of 33 positions in the \$1,200 class, with a corresponding increase in the number of places above that salary, as requested in the estimates for the present fiscal year. The present and proposed classifications are shown below.

Grade.	Office force, 1918.			Estimates, 1919.		
	Number.	Salary.	Amount.	Number.	Salary.	Amount.
Director.....	1	\$6,000	\$6,000	1	\$6,000	\$6,000
Chief statisticians.....	5	3,000	15,000	5	3,000	15,000
Statistical and technical expert.....	1			1	3,000	3,000
Chief clerk.....	1	2,500	2,500	1	2,500	2,500
Geographer.....	1	2,000	2,000	1	2,000	2,000
Stenographer.....	1	1,500	1,500	1	1,500	1,500
Expert chiefs of division.....	9	2,000	18,000	9	2,000	18,000
Clerks:						
Class 4.....	15	1,800	27,000	23	1,800	41,400
Class 3.....	25	1,600	40,000	35	1,600	56,000
Class 2.....	40	1,400	56,000	110	1,400	154,000
Class 1.....	253	1,200	303,600	250	1,200	300,000
\$1,000.....	83	1,000	83,000	93	1,000	93,000
\$900.....	81	900	72,900	91	900	81,900
Skilled laborers:						
\$900.....	2	900	1,800	3	900	2,700
\$720.....	1	720	720	1	720	720
Messengers.....	3	840	2,520	3	840	2,520
Assistant messengers.....	5	720	3,600	5	720	3,600
Unskilled laborers.....	4	720	2,880	5	720	3,600
Messenger boys.....	3	480	1,440	4	480	1,920
Total.....	563		676,460	642		789,360

Under the proposed classification, as set forth in the above table, 29.1 per cent of the Bureau's force will be paid salaries higher than \$1,200 per annum. Even this proportion, although greater than the corresponding one for the present year, is still materially below that for the other branches of the departmental service taken as a whole, which, as already pointed out, was 36.1 per cent in 1912.

The matter is treated at this length because it seems apparent that conditions which threaten the integrity of the force of the Census service just prior to undertaking another decennial census are not understood by Congress. If the existing conditions were realized, we should hardly have received, during the fiscal year ended June 30, 1917, 107 inquiries from Senators and 81 inquiries from Representatives about the promotion of employees of this service, for it would have been recognized that until Congress itself acts, anything like adequate opportunity for promotion for the employees of this Bureau is impossible.

In conclusion, stress is laid on two facts:

First, that unless the Census Bureau's salary scale is made more nearly comparable with the salary scales prevailing elsewhere in the Government service, as provided for by the estimates for the coming fiscal year, the drain on its force will continue unchecked, with the result that the Bureau will be utterly unable to maintain the standard of excellence in statistical work which it has heretofore established.

Second, that unless the Bureau is given an increase of force, as called for by the estimates, it will be unable to collect and publish its statistics as promptly as it has been doing; and what is still more important, it will be prevented from making proper preparations for the Fourteenth Census, as the fiscal year for which the additional position have been requested is the one immediately preceding the beginning of the Fourteenth Census period on July 1, 1919.

## Appendix C.—SALARIES OF LIGHTHOUSE INSPECTORS.

### Law Respecting Lighthouse Inspectors.

The act of June 17, 1910 (36 Stat., 538), provides that "a lighthouse inspector shall be assigned in charge of each district," and that "the lighthouse inspectors shall each receive a salary of \$2,400 per annum, except the inspector of the third district, whose salary shall be \$3,600 per annum."

### Duties of Inspector.

The designation "inspector" does not describe correctly the duties of the officer in charge of a lighthouse district, who is really the chief executive of the lighthouse work of the district, with important and responsible administrative and technical duties. He is both an engineering and executive officer.

The Regulations for the United States Lighthouse Service, prescribed in accordance with the act of June 17, 1910, charge the lighthouse inspector with the following duties:

The supervision of all the work of the district in which he is assigned to duty, and he is responsible under the Commissioner for its efficient and economical administration.

He is responsible for the proper management of the light stations, fog-signal stations, light vessels, relief light vessels, lighthouse tenders, and depots; for keeping upon their stations in proper condition all floating aids to navigation; for the maintenance, repair, and operation of all lighthouse craft permanently or temporarily in the district; for the construction of new aids or additions to aids; for the repair, cleanliness, and efficient condition of all aids to navigation and other property in the district; for keeping ready for service at the shortest notice all spare or relief moorings, buoys, buoy appendages, and relief light vessels; for the distribution of supplies; for the efficiency of the personnel; for the approval of vouchers and accounts covering the disbursement of funds as may be authorized on account of the Lighthouse Service; and for such other duties as are involved in the proper conduct of the district or as may be from time to time assigned to him.

In carrying out these duties, the inspector is to exercise a constant and watchful supervision over all district affairs, as well as over the officers and men in the Service, so as to maintain the district in a high state of efficiency. He shall keep advised of the needs of navigation as respects aids to navigation in his district.

Each inspector is responsible for—

Government property, average value per district, estimated. ....	\$3, 000, 000
Vessels, average number per district. ....	7
General coast line, average length per district. .... miles..	1, 000
Aids to navigation per district, average. ....	750
Employees per district, average. ....	280
Annual disbursements, average per district. ....	\$304, 000

### Qualifications Necessary in Lighthouse Inspectors.

Technical knowledge of work of the Lighthouse Service.

Business ability for economical and efficient handling of work.

Vigilance for protection of safety of navigation.

Engineering training and experience, including practically all branches of engineering.



Nautical knowledge and experience.

Ability to act on independent initiative and responsibility, on account of distance from headquarters (average 1,300 miles), and necessity for immediate action in emergencies.

Ability to act and cooperate with representative citizens, local officers, and other Government officers, in the cities and districts in which stationed, in furtherance of the needs of navigation.

Efficient supervision of a widely scattered personnel.

#### Comparison of Annual Salaries.

Lighthouse inspectors (except third district), each (no retirement pension)...	\$2,400
Naval officer and Army Engineer officer (part of time) replaced by each light-house inspector, average pay and allowance per district.....	5,000
Assistant engineers, War Department, under Engineer officers and not charged with independent responsibility, average in 16 cities.....	3,300
Captains in Coast Guard service (also retirement pension).....	4,000
Superintendents, Coast Guard service (formerly Life-Saving Service) including longevity pay (also retirement pension).....	3,000
Supervising inspectors, Steamboat-Inspection Service.....	3,000
Field force, Coast and Geodetic Survey, 14 officers receive from.....	\$2,500 to 4,000

The officers mentioned who serve in other important Government services are not charged with greater responsibilities, nor do they require any greater variety of qualifications than the lighthouse inspectors.

#### Present Status of Lighthouse Inspectors.

The necessity for an increase in the compensation of these officers has now become much more urgent than it ever was in the past. Lighthouse inspectors have to be stationed in the larger ports of the United States. Their duties require them to constantly cooperate and do business with officers and civilians receiving very much higher salaries than they, as indicated in the comparison above. As conditions are, it is impossible for these men to live with their families in the cities where they are stationed in a manner befitting their position. They can not move to places where living costs less.

Another consideration which should be weighed is the fact that in accordance with the naval appropriation act of August 29, 1916, and the Executive order of the President of April 11, 1917, transferring certain portions of the Lighthouse Service to the service of the War and Navy Departments, and under the regulations governing the duties to be performed by the Lighthouse Service in time of war, lighthouse inspectors have been ordered to report for duty with the Navy and Army authorities in their respective districts. These officers are therefore in active cooperation with the military authorities and have been of great assistance in the various districts where they are stationed by planning the work of the lighthouse vessels to perform the necessary military duties, and by furnishing equipment and buoys, etc., as required, in addition to carrying on the regular work of the Lighthouse Service. They have been and are now doing this work without any of the emoluments or military standing of officers of the Army and the Navy, and although in positions of broad responsibilities their compensation is only comparable to that of officers of relatively junior grades in those services. In fact, considering pay and allowances, the only grade of commissioned officers in the Army and the Navy who receive less than lighthouse inspectors are ensigns in the Navy, and second lieutenants in the Army, whose total compensation is but slightly below the present authorized pay of lighthouse inspectors. The condition is one of serious injustice to the latter officers.

**Previous Statements on the Subject.**

The inadequate compensation of lighthouse inspectors has been previously mentioned in the annual reports of the Secretary of Commerce as follows: Annual Reports 1915, p. 145, and 1916, p. 54 and 159.

It has also been brought up in each annual report of the Commissioner of Lighthouses since the reorganization of the Lighthouse Service on July 1, 1910. (See Annual Reports 1911, p. 26; 1912, p. 27; 1913, p. 27; 1914, p. 25; 1915, p. 25; 1916, p. 24; 1917, p. 26.)

It has also been covered in hearings before the congressional committees on appropriations on the sundry civil bills of the following fiscal years: 1912 (Jan. 30, 1911, p. 650, House); 1913 (Apr. 30, 1912, p. 1611, House); 1913 (July 3, 1912, p. 166, Senate); 1914 (Feb. 7, 1913, p. 967, House); 1915 (Apr. 30, 1914, p. 1357, House); 1916 (Jan. 11, 1915, p. 507, House); 1917 (Mar. 27, 1916, p. 1055, House), 1918 (Feb. 5, 1917, p. 1068, House).

In addition to these hearings, attention is also invited to page 28 of the hearings of April 1, 1916, before the Committee on Interstate and Foreign Commerce, of the House of Representatives, Sixty-fourth Congress, first session, and to the very extensive hearings embracing 27 pages, before the Senate Committee on Commerce on January 18, 1917, when considering the bill S. 7893, covering recommended legislation for the Lighthouse Service.

This provision for increased salary of lighthouse inspectors was favorably considered by the committees of both houses of Congress, and was included in the bill H. R. 14338 as reported by the Committee on Interstate and Foreign Commerce April 15, 1916, and in the bill S. 21 as reported by the Committee on Commerce May 29, 1916, and as passed by the Senate July 27, 1916, all in the Sixty-fourth Congress, first session. The same provision is also included in House bill 2298 and Senate bill 993 (65th Congress, 1st session). The bill, H. R. 2298, was favorably reported by the Committee on Interstate and Foreign Commerce on September 21, 1917, but no action was taken owing to adjournment on October 6, 1917.

**Recommendation.**

The following legislation is recommended:

Hereafter a superintendent of lighthouses shall be assigned in charge of each lighthouse district, at an annual salary of not exceeding \$3,600, each: *Provided*, That officers now designated as lighthouse inspectors shall be transferred to the positions of superintendent of lighthouses herein submitted in lieu of lighthouse inspectors: *And provided further*, That in the districts which include the Mississippi River and its tributaries the President may designate Army Engineers to perform the duties of and act as superintendent of lighthouses without additional compensation.



## Appendix D.—VESSELS AND LAUNCHES FOR THE COAST AND GEODETIC SURVEY.

### Vessels.

The present world conflict is bringing about many changes affecting the individual and the Nation. Prior to it most of our marine commerce was carried in foreign bottoms. Now, we have awakened to the supreme necessity of providing American-owned vessels for carrying our commerce abroad, and a great Government enterprise is working at the task.

With this knowledge that there is to be a large American fleet of merchant vessels, it is proper to examine how well our waters have been surveyed for dangers to them, and what facilities there are to complete the surveys for making the charts to guide the navigators of this new fleet and save the vessels from wreck. I have set forth on pages 200 to 212 of my annual report the condition of the surveys of our coasts. It is my present purpose to consider the means at hand and those that are needed to bring these surveys to such completeness that the loss of vessels can not be ascribed to lack of reliable charts and sailing directions.

In the past the Bureau has been inadequately equipped for this work, but conditions are at their worst now when the American merchant marine will soon exceed anything in our history. Since the Government is spending vast sums to provide a merchant marine, it is "good business" to take normal precautions that these vessels may safely navigate our waters.

Hereafter it will be chiefly American vessels rather than foreign ones that will be lost for lack of proper surveys, of sufficient wire-drag work, of thorough current observations. The dollars to pay for the wrecks will be American dollars; the lives at risk will be those of our countrymen. The losses of life and property in the past have run into alarming totals. The means of preventing those losses are less to-day than they have been for years past.

The Alaska bureau of the Seattle Chamber of Commerce some 12 months ago prepared a map on which are indicated a total of 50 vessels lost in Alaskan waters since 1905. No information is given as to what number of these disasters was due to deficient charts, yet our surveys of Alaska are far behind those of our other coasts, and an alarming proportion of these wrecks must have been due to lack of reliable knowledge of the waters.

The natural resources of Alaska have so tempted commerce that vessels have ventured into those regions far in advance of adequate surveys. The means of the Coast and Geodetic Survey for charting Alaskan waters have been, and are, so limited that the best that could then be done, and can now be done, is to shift from place to place and make examinations where industry has preceded surveys and dangers have been found by vessels striking them, or where industry has established itself and demands a local survey.

The equipment for these surveys is so limited that no definite plan can be laid for their ultimate completion or for the issuing of charts that will be guides to all parts of Alaskan waters.

The making of surveys and supplying reliable charts for the American merchant marine is a question of the number of surveying vessels and wire-drag launches available for the work.

Omitting for the present the equipment for surveys in the Philippine Islands, the Coast and Geodetic Survey has for the survey of the Atlantic and Pacific coasts of

continental United States, the waters of Alaska, Porto Rico, Hawaii, Virgin Islands of the United States, and the approaches to the Panama Canal, the following small and partly superannuated fleet:

1. The *Surveyor*, newly built. This vessel is the result of the experience of the officers of the Bureau in designing a vessel for the attainment of the maximum results with the least expense. She is a steel steam vessel of 1,000 tons displacement; 186 feet in length over all; 34 feet in breadth; 12 feet draft; indicated horsepower, 1,000; speed, 11.5 knots; fuel capacity, 75,000 gallons fuel oil; complement, 11 officers and 58 men; built at Manitowoc, Wis., in 1917. Now in Navy.

2. The *Isis*. A steel steam vessel of 377 gross tons and 256 net tons; registered length, 180.4 feet; breadth, 24.8 feet; draft, 11.7 feet; indicated horsepower, 2,000; speed, 16 knots; coal capacity, 120 tons; complement, 8 officers and 44 men. Purchased by the United States Coast and Geodetic Survey July 1, 1915. She was built in 1902 for a strong, seagoing yacht and was the best adapted for the needs of the Bureau of any vessel available at the time purchased. She has been modified to suit the needs of the service and is in fine order. While not so especially fitted for the purpose as the *Surveyor*, the money expended for her could not have been better used to meet the needs of the Survey. Now in Navy.

3. The *Bache*. A composite steam vessel of 472 tons displacement, 370 gross tons, and 252 net tons; registered length, 153.2 feet; breadth, 26.2 feet; draft, 10 feet; indicated horsepower, 400; speed, 10.5 knots; coal capacity, 96 tons; complement, 9 officers and 42 men. Built at Shooters Island, N. Y., in 1901. In good order. Now in Navy.

4. The *Explorer*. A wooden steam vessel of 450 tons displacement, 335 gross tons, and 228 net tons; registered length, 135 feet; breadth, 27 feet; draft, 10 feet; indicated horsepower, 400; speed, 10.3 knots; coal capacity, 85 tons; complement, 7 officers and 40 men. Built at Wilmington, Del., in 1904. In the design and construction of this vessel the utmost useful space was sought within her. To do this, some of the strengthening members usually provided in a vessel were omitted. While during her earlier work no weakness was noticed, she now shows the absence of these members. In rough seas her sides are so pliable that the bolts are subject to a shearing process. If she is continually employed in rough seas, she will soon become too weak to be of service. Not an efficient ship. It is not wise to spend much upon her.

5. The *Hydrographer*. A wooden steam vessel of 146 tons displacement, 116 gross tons, and 79 net tons; registered length, 101 feet; breadth, 19.5 feet; draft, 6.8 feet; indicated horsepower, 250; speed, 10 knots; coal capacity, 22 tons; complement, 5 officers and 18 men. Built at Port Jefferson, N. Y., in 1901. In fair condition.

6. The *Yukon*. A composite steam vessel of 38 gross tons and 25 net tons; registered length, 75 feet; breadth, 15.7 feet; draft, 5 feet; indicated horsepower, 100; speed, 7.5 knots; coal capacity, 16 tons; complement, 4 officers and 13 men. Built at New York in 1898. Really a large launch. Of limited use.

7. The *Patterson*. A wooden auxiliary steam barkentine of 719 tons displacement, 500 gross tons, and 453 net tons; registered length, 163 feet; breadth, 27.3 feet; draft, 14.2 feet; indicated horsepower, 215; speed steaming, 8 knots; coal capacity, 133 tons; complement, 12 officers and 49 men. Built at Brooklyn, N. Y., in 1882. She shows a condition normal to a ship 35 years old after severe service.

8. The *Matchless*. A wooden two-masted schooner of 118 gross tons and 94 net tons; registered length, 91 feet; breadth, 25 feet; draft, 8 feet; complement, 6 officers and 18 men. Built at Key West, Fla., in 1859. A relic of the days "before the war."

While the Bureau has these six so-called steam vessels, one barkentine, and one schooner for surveying the Atlantic coast, the Gulf, and the Pacific coast of the United

States, the waters of Alaska, etc., if we examine into the condition of these vessels and their suitability for the work, we shall find conditions worse than they look.

The *Surveyor* is, of course, the best-equipped vessel for the work, having been designed for the purpose. She can work in exposed waters and endure the roughest seas. She has fuel capacity to enable her to remain at sea for a long period.

The *Isis* and the *Bache* are sufficiently seaworthy for offshore work in the Atlantic during the greater part of the year, but they are not designed for the exposed waters of California, Oregon, and Washington, and the outside waters of the Alaskan coast. They have not the fuel capacity requisite for this work. The *Surveyor* is ideal in respect to her fuel capacity, using fuel oil instead of coal and therefore able to remain at sea almost the entire season; with her as a basis of comparison, it is correct to say that for offshore work 20 per cent of the time of the coal-burning vessels is required to replenish their fuel supply. The percentage of time lost varies of course with localities. If the vessel is working where there are many stations where coal can be secured, not so much time is lost, but if she is working off a coast where supply stations are few and far between, then more than 20 per cent of the time is lost. There is, however, much more of the kind of work which the *Isis* and the *Bache* are well suited to do than can ever be done by them.

The *Explorer*, through the faulty construction mentioned above, is too weak to be exposed to the rough waters of outside surveys and must operate only in protected waters. It is not safe to send her to sea.

The *Hydrographer* and the *Yukon* are too small for any outside work. They must be employed on inside work.

The barkentine *Patterson* is too weak to be used in exposed waters and too expensive in operation to be used as a house boat for inside surveys. She has lately been employed in making surveys of the inside Alaskan waters but is such an antiquated tool that the overhead cost of operation makes the results far less in quantity and more costly than they would be with a modern vessel. The *Patterson* was built 35 years ago.

The schooner *Matchless* was built 58 years ago and can serve no purpose now except as a house boat from which parties can operate in making surveys of inland waters.

Therefore the service has but one vessel (the *Surveyor*) suitable for outside work in all weathers; two vessels (the *Isis* and the *Bache*) suitable for some outside work but without the fuel capacity of the *Surveyor* and therefore necessarily operated where fuel stations are easily available; two small vessels for inside work (the *Hydrographer* and the *Yukon*); one old barkentine (the *Patterson*) too weak for outside work and too expensive in maintenance to use for a house boat; and one old schooner used as a house boat.

With such an outfit no general plan of surveying operations can be put into effect. Appropriations are dissipated here and there in detached surveys as industry and commerce develop in one section after another, or in making examinations where there are reported dangers.

The vessels, therefore, are not only too few for the work, but are not of the required character. This is at a time when the needs for hydrographic surveys were never so great.

There are many square miles requiring original surveys along the coasts of Alaska, Washington, and Oregon that should have immediate attention. During the fiscal year ended June 30, 1917, there were but three vessels available for work along this entire coast line, the *Taku* (now condemned), the *Patterson*, and the *Explorer*. Because the need was greatest there, they were sent to Alaskan waters. Nothing was done along the coasts of Washington, Oregon, and California.

On the other hand, the work is progressing more satisfactorily in the waters of the Philippine Islands, where four surveying vessels are supplied for the work by the Philippine Government and one by the United States.

The vessel supplied by the United States for work in the Philippine Islands is the *Pathfinder*. She is a steel steam vessel of 875 tons displacement, 690 gross tons, and 469 net tons; registered length, 168 feet; breadth, 33.6 feet; draft, 13 feet; indicated horsepower, 846; speed, 12.6 knots; coal capacity, 240 tons; complement, 15 officers and 70 men. Built at Elizabeth, N. J., in 1899.

The *Pathfinder* is engaged in surveys of the Philippine Islands under the provisions of the joint agreement between the Governments of the United States and the Philippine Islands, entered into with the approval of the Secretary of the Treasury. This agreement is in part as follows:

The United States to maintain at least one of its large surveying vessels in the Philippine Islands and to pay the entire running expenses of this vessel.

Figure 1 presents by diagram and statistics the relative progress of hydrographic surveys of the coasts of Alaska, California, Oregon, and Washington, and of the Philippine Islands.<sup>a</sup>

*Not a vessel was provided for the Coast and Geodetic Survey between 1903 and 1915. In 1915 the Endeavor, then 53 years old and for years unfit for real service, was condemned and sold. In 1916 the Godney, then 41 years old, and the McArthur, then 40 years old, being unsafe to use, were condemned and sold. In 1915 the Isis was purchased to replace the Endeavor. This year the Surveyor was built to replace the Godney. The Bureau now has one less vessel for making surveys than it has had during the past 12 years, and of the number in commission to-day, one is 58 years old and of little use, another is 35 years old and very expensive to maintain, another is structurally so weak that she can be operated only in protected waters on work that could be done as quickly and much more cheaply were the proper facilities at hand.*

The cost of keeping these old vessels in repair is excessive. On account of their age these repairs are limited to the minimum that will keep them temporarily in a going condition. Last year repairs to the extent of \$5,795 were made on the *Patterson*. Her average yearly repair bill is \$6,638.43.

During the fiscal year 1917 the cost of repairs to the *Matchless* was \$1,538.25 and her average yearly repair bill is \$1,663.20. The *Explorer's* repair bill for 1917 was \$6,580, and the average yearly expenditure on her for that purpose is \$6,735.96. Much of this outlay is merely enforced waste.

**Notes on Estimates and Hearings.**

## 1915.

The need of additional vessels for the Bureau was placed before Congress in the estimates for the Coast and Geodetic Survey for 1915. (Book of Estimates for fiscal year ended June 30, 1915, p. 603.)

Hearings on these estimates were had before the House Appropriations Committee April 30, 1914, and May 4, 1914. (Hearings before subcommittee of House Committee on Appropriations, sundry civil bill, 1915, p. 1360, 1361, 1399, and 1400.)

The sundry civil bill for 1915 (H. R. 17041) as reported by the House Appropriations Committee, Sixty-third Congress, second session, on June 4, 1914, contained no provision for vessels or launches for the Coast and Geodetic Survey.

Senate hearings on the same bill were held June 26, 1914. (Senate Hearings, 1915, p. 47, 48, and 49.)

In the sundry civil bill for 1915, as reported by the Senate Appropriations Committee July 6, 1914, provision was made for two new vessels, including their equipment, \$175,000. (H. R. 17041 as reported by the Senate Appropriations Committee, p. 140.)

The sundry civil bill as approved for the fiscal year ended June 30, 1915, contained no provisions for vessels or launches for the Coast and Geodetic Survey.

<sup>a</sup> Figures 1 to 16 follow p. 274.

## 1916.

The matter was again brought before the Congress in the estimates for 1916. (Book of Estimates, 1916, p. 869.)

Hearings were had on these estimates before the House Appropriations Committee January 11, 1915. (Hearings before House Appropriations Committee, sundry civil bill, 1916, p. 566, 567, and 568.)

In the sundry civil bill (H. R. 21318) for the fiscal year ended June 30, 1916, as reported by the House Appropriations Committee to the House, February 4, 1915, provision is made "for two new vessels, including their equipment, \$289,000," for the Coast and Geodetic Survey.

So far as can be learned, there were no published hearings before the Senate Appropriations Committee on the sundry civil bill for 1916.

The sundry civil bill for the fiscal year ended June 30, 1916, as reported by the Senate Appropriations Committee February 18, 1915, provides "For two new vessels, including their equipment, \$289,000," for the Coast and Geodetic Survey.

The sundry civil bill as approved for the year ended June 30, 1916, contains the following for the Coast and Geodetic Survey: "For two new vessels, including their equipment, \$289,000."

## 1917.

In the estimates for June 30, 1917, 2 new vessels, \$508,000, and 10 new launches, \$100,000, were requested for the Coast and Geodetic Survey. (Book of Estimates, 1917, p. 1013.)

Hearings on these estimates were held before the House Appropriations Committee on March 29, 1916. (Hearings House Appropriations Committee, 1917, p. 1166, 1167, 1168, 1169, and 1170.)

House Appropriations Committee, Sixty-fourth Congress, first session, reported sundry civil bill for 1917 (H. R. 15836) May 19, 1916, without any provision for vessels or launches for the Coast and Geodetic Survey.

So far as can be learned there are no published hearings before the Senate Appropriations Committee on the sundry civil bill for 1917.

There is no provision for vessels or launches for the Coast and Geodetic Survey in the sundry civil bill for 1917 as reported by the Senate Committee on Appropriations, June 26, 1916.

There is no provision in the sundry civil bill as approved for the year ended June 30, 1917, for vessels or launches for the Coast and Geodetic Survey.

## 1918.

In the estimates for 1918, two new vessels, \$708,000, and eight or more launches, \$125,000, were requested for the Coast and Geodetic Survey. (Book of Estimates, 1918, p. 779.)

Hearings on these estimates were had before the House Appropriations Committee February 3, 1917. (Hearings, House Appropriations Committee, 1918, p. 1142, 1143, 1144, and 1145.)

There is no provision for vessels or launches for the Coast and Geodetic Survey in the sundry civil bill for 1918 as reported by the House Committee on Appropriations, February 19, 1917 (H. R. 20967).

Hearings on these estimates were had before the Senate Appropriations Committee, April 7, 1917. (Hearings, Senate Appropriations Committee, 1918, p. 51 to 58.)

The Senate Appropriations Committee, Sixty-fifth Congress, first session, reported sundry civil bill for 1918 (H. R. 11), April 9, 1917, without any provision for vessels or launches for the Coast and Geodetic Survey.



On April 11, 1917, the matter was discussed on the floor of the Senate. (Congressional Record, Apr. 11, 1917, p. 504 to 508.)

In the sundry civil bill (H. R. 11) for the fiscal year ending June 30, 1918, as ordered printed by the House with amendments of the Senate numbered, April 13, 1917, there is the following: "Two new vessels for the Coast and Geodetic Survey, including their equipment, to replace the *Patterson* and *Gedney*, \$708,000."

There is no provision in the sundry civil bill as approved for the year ending June 30, 1918, for vessels or launches for the Coast and Geodetic Survey.

#### Wire-Drage Launches.

There is another branch of the hydrographic work of the Bureau that does not progress as it should because there are no Government-owned vessels of the type needed for the work. These are the wire-drag launches.

To digress a little and point out (1) the characteristics of the formation of our coasts, (2) why the wire drag is the only means of detecting dangers to navigation where certain classes of formation prevail, and (3) what the wire drag is, may lead to a better conception of why a special type of vessel is suited for this work, and why it is *wasteful* to work with rented vessels, as is now done.

Our coasts may be divided into three classes, which with their general lineal extent in statute miles are, as follows:

	Miles.
Rocky (therefore generally fixed and unchanged by the action of tides and currents):	
From the northern coast boundary of Maine to the entrance to New York harbor.....	600
The Pacific coast of continental United States.....	1,366
The coast of Alaska from Dixon Entrance around to Bristol Bay.....	3,850
The approaches to the Panama Canal.....	71
Porto Rico.....	122
Total.....	6,009

#### Coral:

From Palm Beach, Fla., around to Cedar Keys, Fla.....	567
All of the coasts of Porto Rico except part of the northern and part of the western shores of the main island of Porto Rico.....	189
The coasts of Guam, Hawaii, and the Philippine Islands.....	4,923
Total.....	5,679

#### Sand and mud flat formation (therefore subject to change from the action of tides and currents):

From New York harbor to Palm Beach, Fla.....	1,194
From Cedar Keys around the coast of the Gulf of Mexico to the Mexican boundary.....	1,156
From Bristol Bay around the Alaskan coast to the one hundred and forty-first meridian.....	2,790
Total.....	5,140

The three illustrations herewith (figs. 2, 3, and 4) graphically show the characteristics of our shores.

*The wire drag is the only means of detecting dangers to navigation where certain classes of formation prevail.*

In making hydrographic surveys the common method is to find the depth (unless the depth is excessive) by dropping overboard by hand a lead weight attached to a line. There are, however, dangers to navigation which can not be detected by such

a method. No better illustration of this class of danger exists than the pinnacle rocks of Alaska. In these waters one sees on every hand mountain ranges whose profiles present a confusion of sharp, jagged peaks, some appearing above the water as precipitous islets, those of less elevation rising to within a few feet of the surface, others still lower, rising but little above the bottom.

It is the problem of the hydrographic engineer to discover and chart these hidden pinnacles rising up from the depths waiting to rip open the bottom of the unfortunate ship that passes that way. The navigator who can detect other dangers to his vessel with some accuracy has no means of divining the presence of these hidden menaces of the sea. The lead can not find them. Only the wire drag will disclose their presence.

It is difficult to explain in words how elusive these dangers are when sought with the hand lead. Even in cases where vessels have struck such rocks, so that their location is fixed within a field of search limited to an area perhaps 100 yards square, it sometimes takes days of work to find the least water on them. How impossible is it, then, to know that in any survey made with the hand lead every danger has been discovered?

Consider again how surveys with the hand lead are made. As the sounding boat moves along on a straight line, the leadsman casts the lead ahead of the boat, reading the depth from the line as the lead strikes the bottom and the line becomes vertical. The point where each sounding was taken is accurately located by observers in the boat who, with sextants, measure the angles between objects on shore.

The sounding lines are parallel and close to one another, the boat moves slowly, and the soundings are taken rapidly, but even so, the area included between any four soundings is comparatively large. Lines spaced 20 yards apart, with soundings 10 yards apart in each line, would be considered a close survey. Yet the area bounded by two soundings on each of two adjacent lines is 200 square yards, which is ample to contain a boulder or pinnacle rock 10 yards in diameter which would be undetected by the soundings.

When it is remembered that the work must often be done in a choppy sea or in currents, so that the boat can not always be kept on the line, and that the lead will strike a steep-sided rock and slide off, it becomes obvious that it is impossible to find every hidden danger by means of the lead. (See fig. 5.)

In Buzzards Bay, Mass., over an area in excess of 21 square miles, 91,000 soundings had been taken with the hand lead line. From these soundings a chart had been issued which said that in this region the mariner might expect to find no less than 31 feet of water. But in this very area the cruiser *Brooklyn* touched a rock that reached up to within 18 feet of the surface and which had been missed by the hand lead line. (See fig. 6.)

Out of this and like experiences, confidence was lost in surveys made with the hand lead line in regions where pinnacle rocks, isolated boulders, or coral reefs rise abruptly from the general contour of the bottom.

Some more certain method than the lead line must be used in such areas. The method of dragging a wire or rope through the water had been first employed by French engineers and later by the United States Army Engineers. From this beginning has been developed the modern wire drag by the Coast and Geodetic Survey, which has grown into a wonderful mechanism for rapidly covering extensive areas and yet finding within the area covered every existing pinnacle rock, boulder, or coral reef that rises above the depth to which the drag is set.

Prior to 1916 Salem harbor and approaches, Mass., had been covered by three lead-line hydrographic surveys, in 1850, in 1858, and in 1894-5. Then, in 1916 a wire-drag survey was made. The two drawings opposite show what this wire-drag survey disclosed. One of these drawings is of Salem harbor and approaches. Within the harbor and approaches are shown in red 45 numbered shoals and rocks that were found

by the wire drag. The other drawing shows how far below the surface the bottom of the harbor and approaches was said to be on our earlier charts, and how much above his general bottom the wire-drag survey showed that these rocks and boulders actually extended. The fact that some of these rocks rise only a short distance above the bottom does not necessarily reduce the hazard involved. If the chart shows 18 feet of water where traffic must pass and a vessel draws 15 feet of water, she clears the bottom by but 3 feet. If then, an isolated boulder in this area extends 5 feet above the bottom, trouble is imminent. As stated above, this survey of Salem harbor is characteristic of the "finds" of this kind *wherever the wire drag has gone*. (See figs. 7 and 8.)

Figures 9, 10, 11, and 12 show other recent "finds" by the wire drag on the Atlantic and the Pacific coasts.

The wire-drag survey, then, examines areas where dangers in the form of pinnacle rocks, boulders, and coral reefs are believed to exist. When the shores are rocky, or there are coral reefs, the survey must be made with the wire drag to insure finding all dangers.

Figure 13 shows the wire drag in operation. Figure 14 shows all the essential units and members that are required to make up a wire-drag outfit for the coast of New England. It will be noted that four power boats are required.

1. The guiding launch, the largest of the four, tows one end of the drag, and controls the drag's course through the water. This launch carries the greater part of the drag, reserve equipment, reels, hoisting engine, anchor engine, suitable guides for setting out and taking up the wire, drafting tables, and signal apparatus. In some cases it is necessary to have special davits for setting out and taking up the large buoys and sinkers. When not in use, the small buoys are carried in racks, and the sinkers are kept in boxes, to prevent their rolling about.

2. The end launch, the next in size, tows the other end of the drag, under instructions from the guiding launch.

3. A third and smaller launch, used as a tender, patrols the drag when in operation, changing the depths at which the drag is operated in order to conform to known differences in depth of water or the rise and fall of the tide, to clear the drag when aground, and to remove lobster pots or other fishing gear in the path of the drag.

4. The fourth launch is used to sound around and determine the exact position of menaces to navigation that are found, allowing the drag to proceed; at other times it assists in the work of the large tender.

The purpose of this statement is to show how much more economically this work would be done if the Government had its own launches, made for this work, instead of renting them from private parties.

Past experience has shown that the rental which the Government pays each season for chartered launches averages one-fifth of their cost. In other words, 5 years' rental would purchase the boats. As the life of such launches is at least 10 years, the Government, with its own boats could get 10 years' service for 5 years' rental. This, of course, omits the cost of upkeep, but for boats of this character that cost is small and is more than offset by other costs which are mentioned later.

Launch rentals are high because:

1. Owners of launches that have never been used for wire-drag work are unfamiliar with conditions, and can not estimate the cost of repairs or wear and tear.

2. The risk of loss or damage must be assumed by the launch owner, though he has no voice in the matter of how and when the launches will be used. Insurance rates are high, especially in Alaska.

3. Heavy-powered, stanch fishing boats are best suited for wire-drag work. Owners of such boats are fairly sure of good earnings from fishing. Therefore, they rent only at a figure high enough to insure a like return.

Launches suitable for wire-drag work are scarce at any price because:

1. Pleasure launches usually have enough power, but their hulls are too weak for the work.

2. Fishing and working launches are generally strong but are usually low powered.

3. Launches with two-cycle engines can not be used for wire-drag tenders, but launches of a suitable size equipped with four-cycle engines are few.

All this results in delay and expense. When it is desired to secure the launch equipment for a season's work, it is not sufficient to send out specifications and proposals, and when the bids come in, to accept the lowest. Instead, the descriptions furnished must be carefully studied, eliminating those which are clearly unsuited for the work. An officer must then go to see the remainder and choose those which afford the most advantageous conditions.

*It is never possible to secure launches suited in all respects to the work. Alterations must invariably be made.* These alterations are necessary to strengthen the decks to carry the weight of the heavy machinery and gear, to provide for the installation of the auxiliary engines, reels, signaling system, etc., used, to clear away rails, awnings, and obstructions on deck, and to suitably protect woodwork or fittings from damage in the handling of heavy buoys or weights. All expense so incurred must be borne by the Government, both for installing the equipment at the beginning of the season and removing it and replacing the launch in its original condition at the conclusion of the work. This expenditure is wasted. When it is all done the Government has no return for it.

These wastes for inspection and alteration would more than pay the upkeep of Government-owned launches. Figures 15 and 16 are from photographs of wire-drag equipment installed on a rented launch.

The yearly average cost to the Government for *installing* the wire-drag machinery on the rented launches and *removing* it at the close of the season, including the time of the field officers utilized for this purpose, was, for *each* of the four parties in the field during the season of 1916, about \$850, or a total of \$3,300. This includes no rent.

A source of frequent complaint from field officers is the fact that, though the rented fishing launches have engine power enough for the wire-drag work itself, they are painfully slow in going to and from the work. Some of the exposed Alaskan waters are being dragged many miles from the nearest harbor. Slow speed means the loss of much working time in the course of a season. It makes a marked difference if the distance is covered twice daily in 1 hour and 40 minutes with a slow fishing boat or in 1 hour with a speedier Government-owned vessel designed for the purpose. This is no fancy, but a fact.

There is this further thing to be said about renting launches for wire-drag work. There are localities where launches can not be hired because there are none. This is true of the coral-infested waters of Porto Rico and the Virgin Islands of the United States. Likewise, the few launches available near Key West are wholly unfit for wire-drag work.

Launches for wire-drag work in southeast Alaska must be secured in Seattle and transported hundreds of miles to the work.

The following correspondence speaks for itself:

NAVY DEPARTMENT,  
Washington, September 26, 1917.

SIR: I have the honor to forward herewith a paraphrase of a cablegram received from the Governor of the Virgin Islands of the United States relative to the inquiries contained in your letter of 6 September:

"It is recommended that a wire-drag survey be taken of the waters between the islands of St. Thomas and St. John in addition to the vicinity of Vieques Sound. It is regretted that there are no motor boats available in this locality for this work. The general conditions of St. Thomas and St. John are mountainous, rugged, dense undergrowth, sloping, thinly populated, and arid. In connection with the topographical survey, the location of property boundaries is most important. It is also recom-

mended that a geological survey, with special reference to the location of suitable sites for artesian wells, be made."

The Navy Department regrets that there are no boats available for assistance in the making of this wire-drag survey, but should a vessel be stationed in that vicinity which carries appropriate boats for this service, orders will be issued for her to assist in every way possible.

The Department will be pleased to be informed as to the action taken relative to the survey of these islands, and to assist in any manner which may be possible.

Sincerely yours,

JOSEPHUS DANIELS.

The honorable the SECRETARY OF COMMERCE.

The following reply was made:

DEPARTMENT OF COMMERCE,  
OFFICE OF SECRETARY,  
September 29, 1917.

SIR: The receipt of your letter dated September 26, 1917, relative to surveys in the Virgin Islands, is acknowledged.

I regret to learn that the Navy Department will be unable to furnish the necessary launches for the wire-drag work in the vicinity of the islands of St. Thomas and St. John and Vieques Sound, as it is understood that no suitable launches can be obtained locally for this work.

Under these circumstances, it appears that the hydrographic work in general will necessarily have to be postponed until the return of the Coast and Geodetic Survey vessels from duty under the Navy Department or until suitable launches can be obtained from other sources.

As stated in previous correspondence from the Coast and Geodetic Survey, officers and equipment for the shore work of the survey of the islands will be sent to St. Thomas at the earliest practicable date. They will be instructed to use any of the small launches that may be found suitable for the local hydrography, upon arrival in the islands, and it is probable that the hydrographic surveys of the bays and harbors can be made during the winter.

Respectfully,

WILLIAM C. REDFIELD, *Secretary.*

The SECRETARY OF THE NAVY,  
*Washington, D. C.*

In concluding this matter, conditions can hardly be better expressed than in a letter recently received from an engineer in charge of a wire-drag party that has been operating in the vicinity of Key West, Fla.:

According to all reports we have been fortunate in having an unusually favorable season for work, but I am afraid that it is about over, for heavy squalls and rain are beginning to make things interesting and the weather seems to be getting generally unfavorable.

It would not be so bad if our end launch could only take care of herself, but it is asking almost too much of a 25-horsepower guiding launch to take up the drag in a heavy squall, that may last five minutes or five hours, and then get a line to the end launch and furnish enough power to give her steerage way.

I wish that the opponents of Government-owned, wire-drag boats could have spent the season with us and personally experienced the constant annoyance and obtained an idea of the inefficiency of the present system of chartering boats, especially in regions where suitable launches are few and far between. I believe that this is the first wire-drag work that has been done almost entirely out of sight of land and in what, because of strong currents, is even worse than the average open sea; and it has been necessary to do it with launches that we would hardly consider adequate for work in Cape Cod Bay.

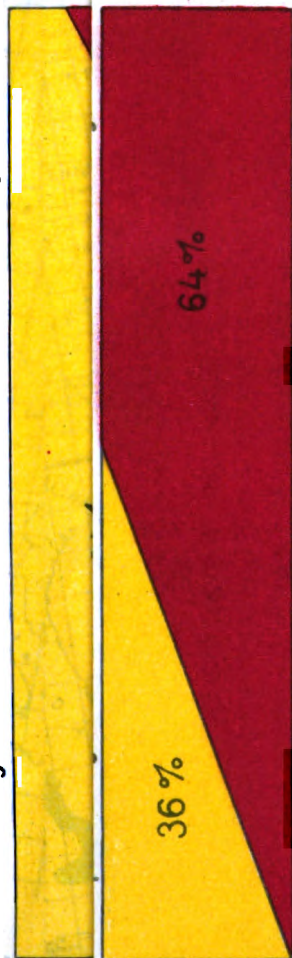
In the four months of actual field work to date we have covered about 225 square miles. Our guiding launch is the most able sea boat for her size that I have ever seen, and I am sure that, with an end launch that could even equal her power and slow speed of 6 to 7 knots, we could easily have covered 100 square miles more.

Of course the present conditions and demands of the Navy for numerous motor boats have increased our difficulty in obtaining suitable launches, but they are not plentiful in this region at any time.

## United States Coast and Geodetic Survey

### Alaska

Owned by the United States since 1867 (50 years)



Yellow (36%) - represents unsurveyed water areas.

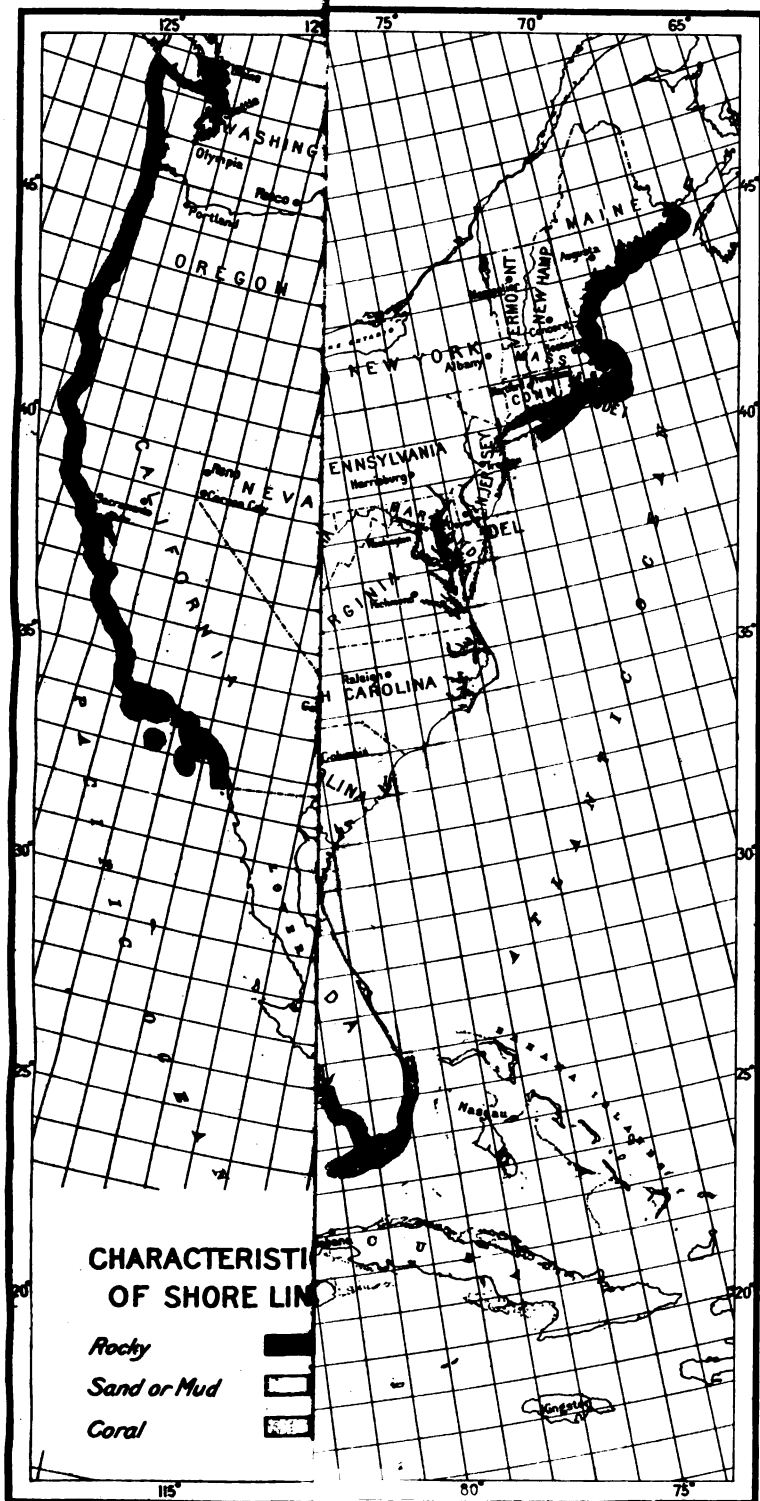
Red (64%) - represents water areas surveyed in past 17 years.

Philippine surveys have progressed more rapidly in 17 years than in the other regions shown on this sheet due to the funds and four (4) ships supplied by the Philippine Government

C & G. S. Print

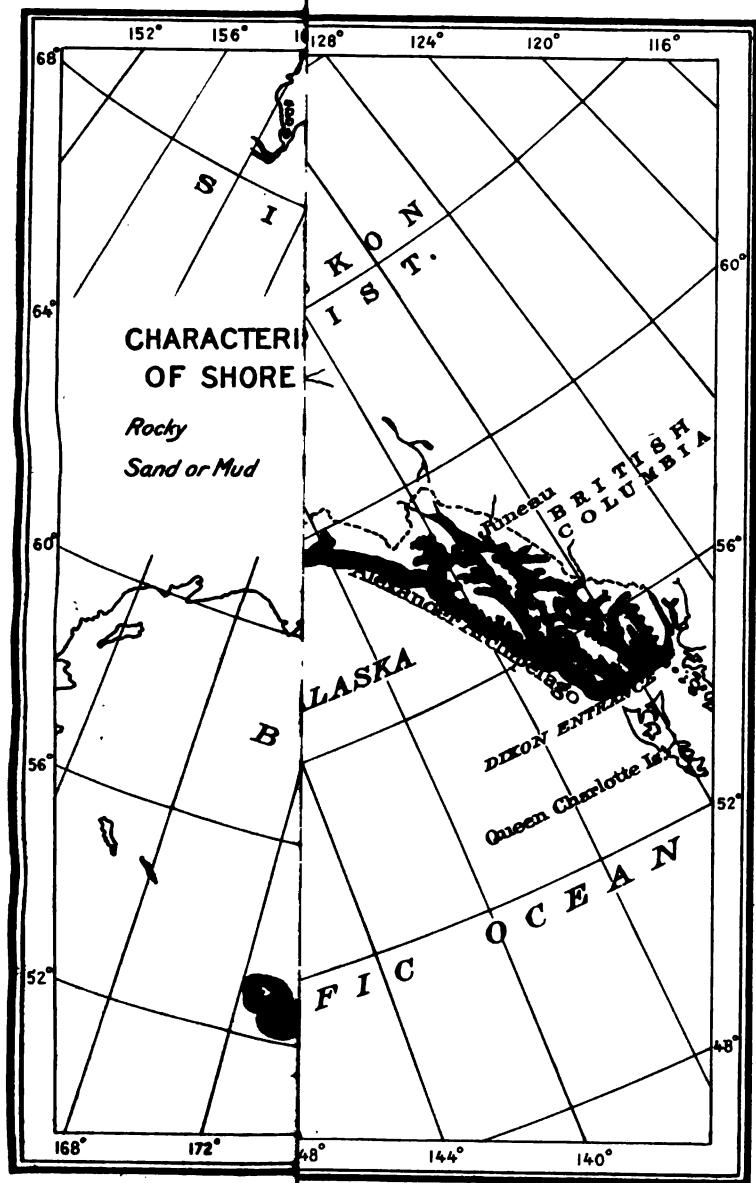
FIG. 1.



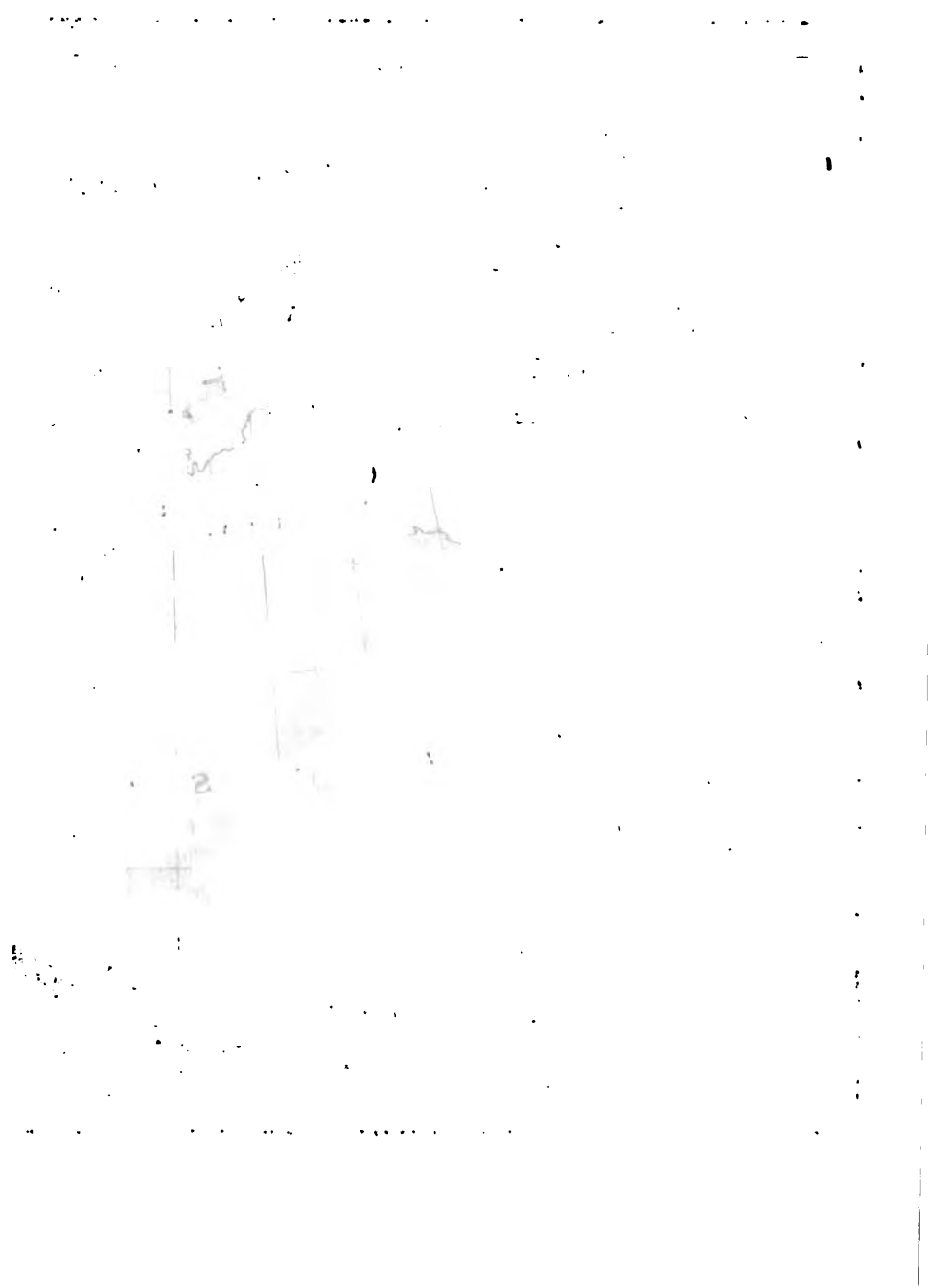


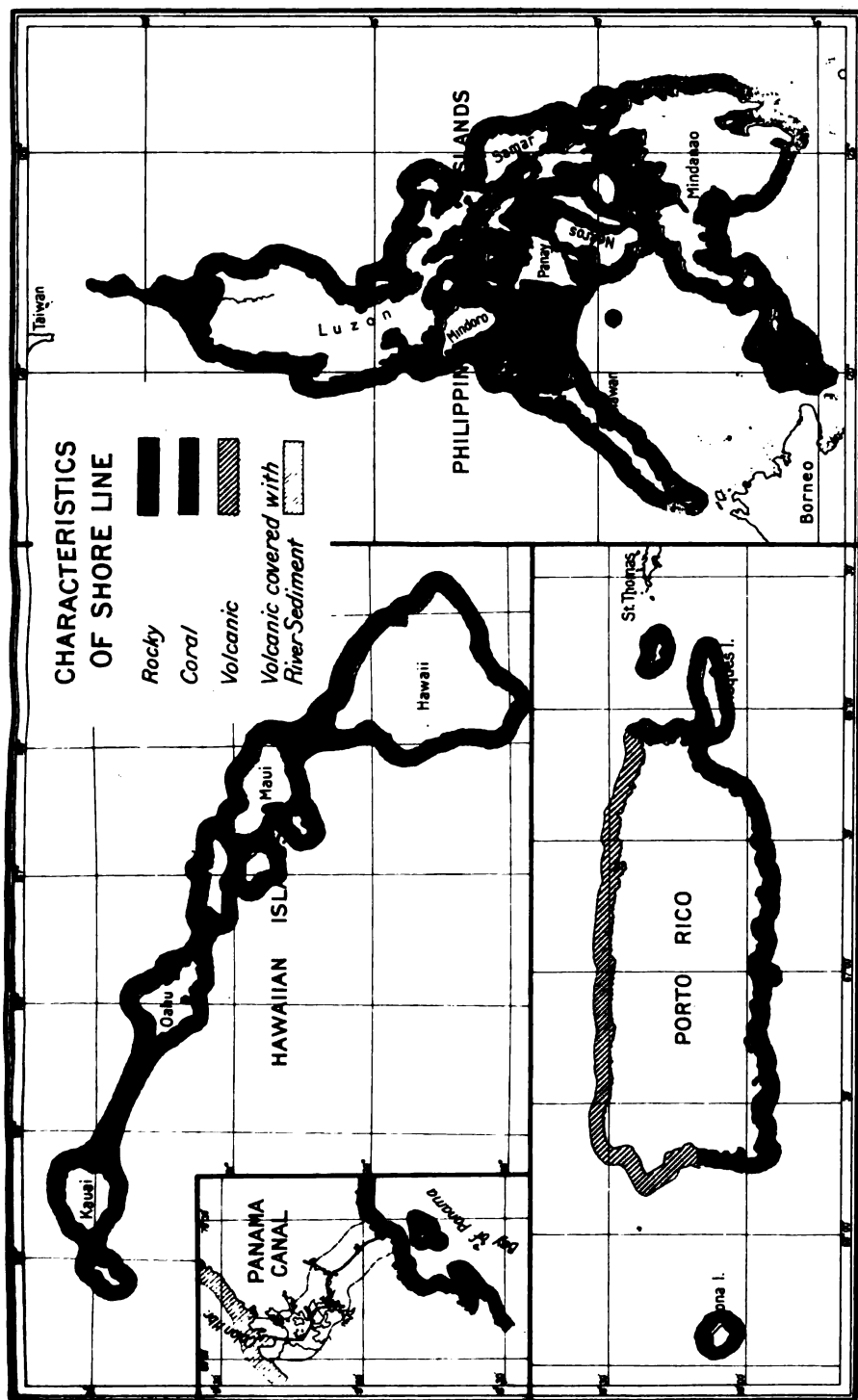






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FIG. 4.



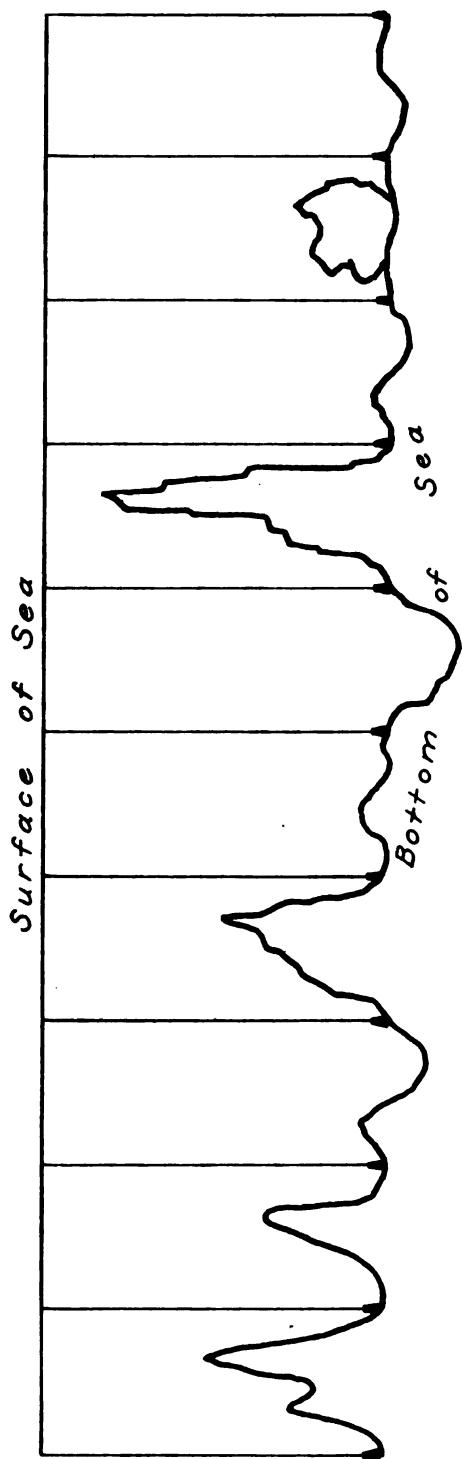


FIG. 5.

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PORTION OF ORIGINAL HYDROGRAPHIC SHEET, BUZZARDS BAY, ON SCALE 1-10000, SHOWING AREA CLOSELY SOUNDED IN 1895, WHERE THE *BROOKLYN* STRUCK IN 1902.

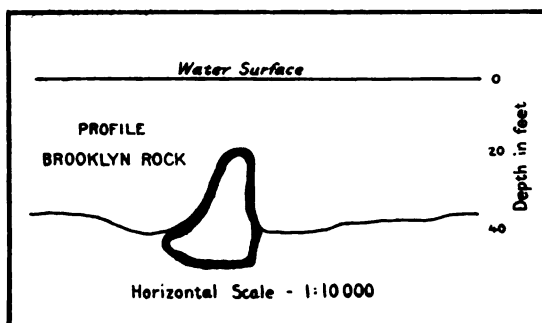
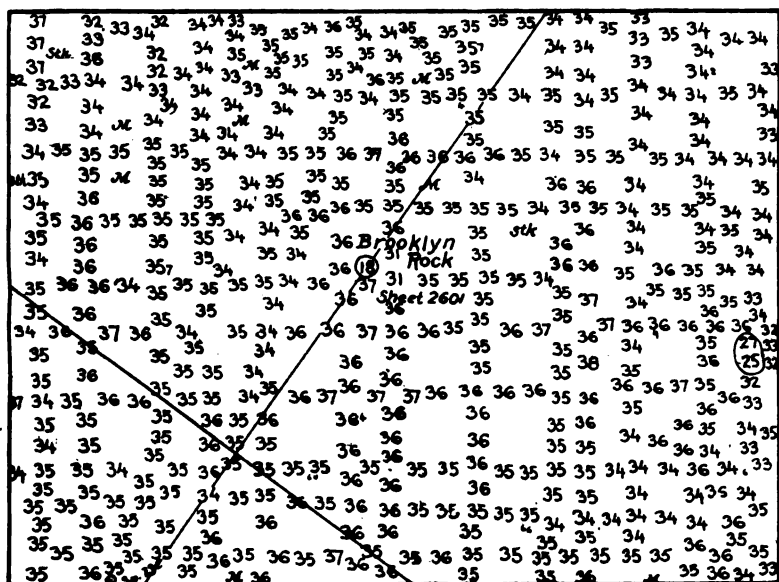


FIG. 6.

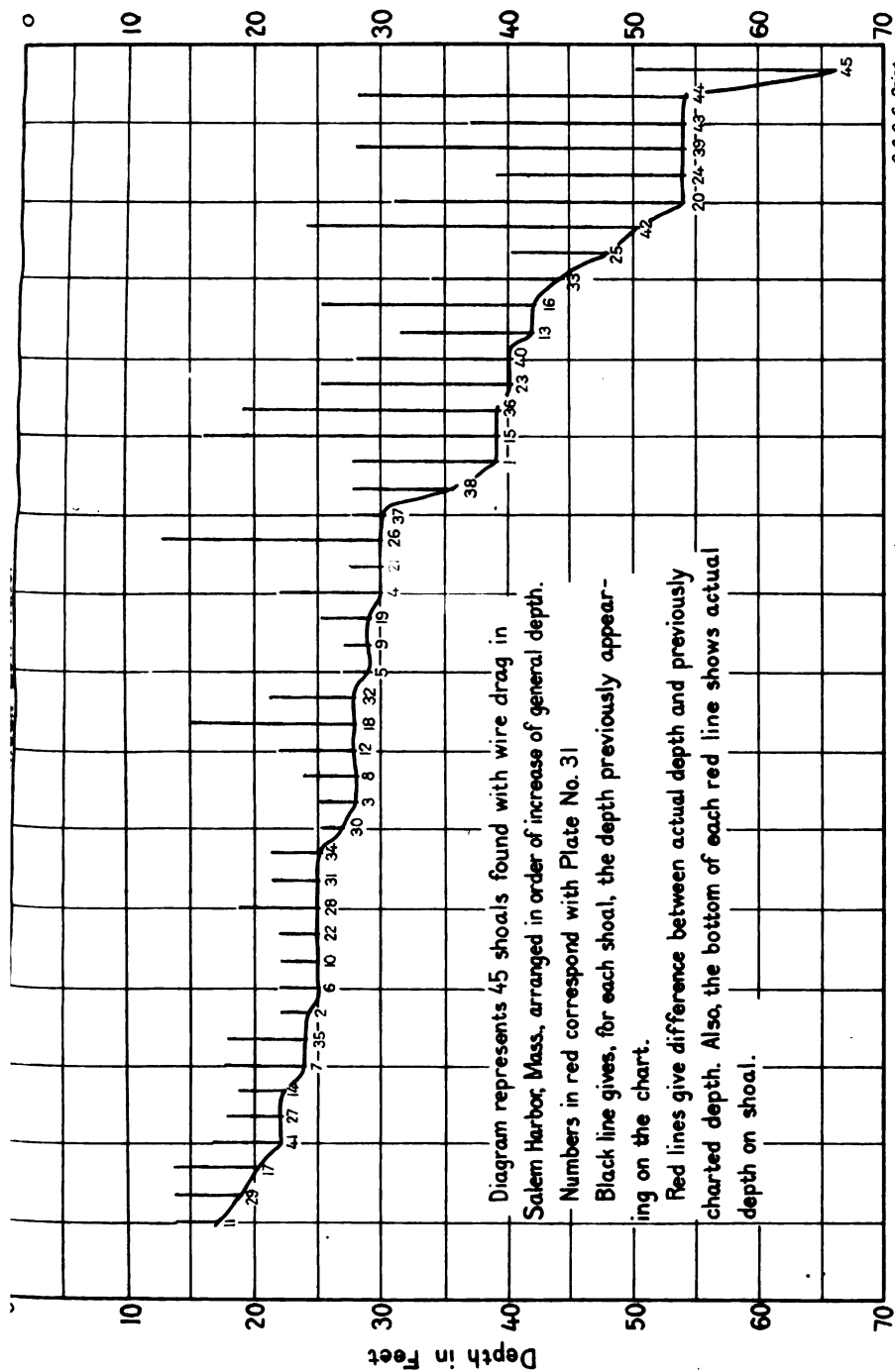
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FIG. 8.



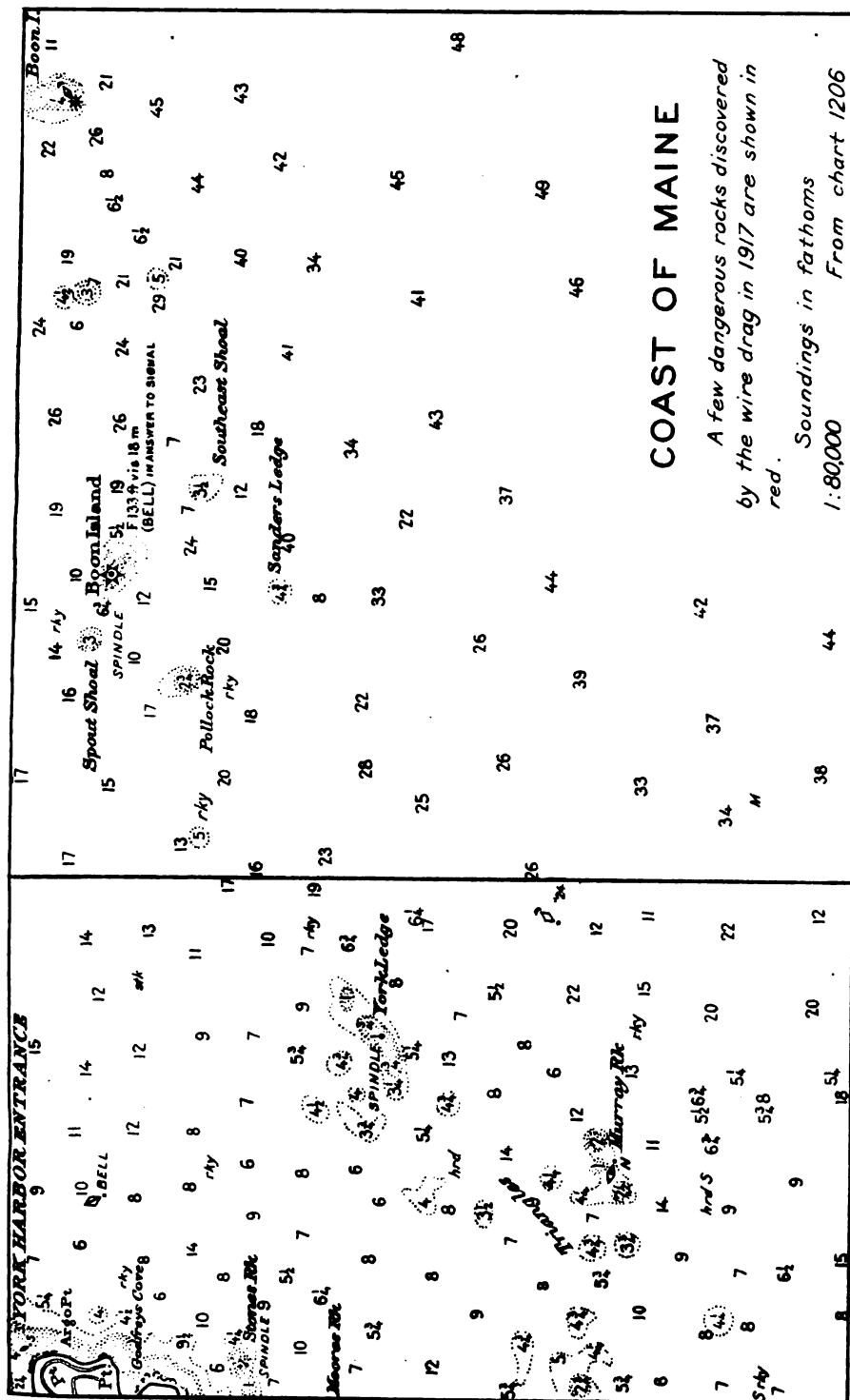


FIG. 9.



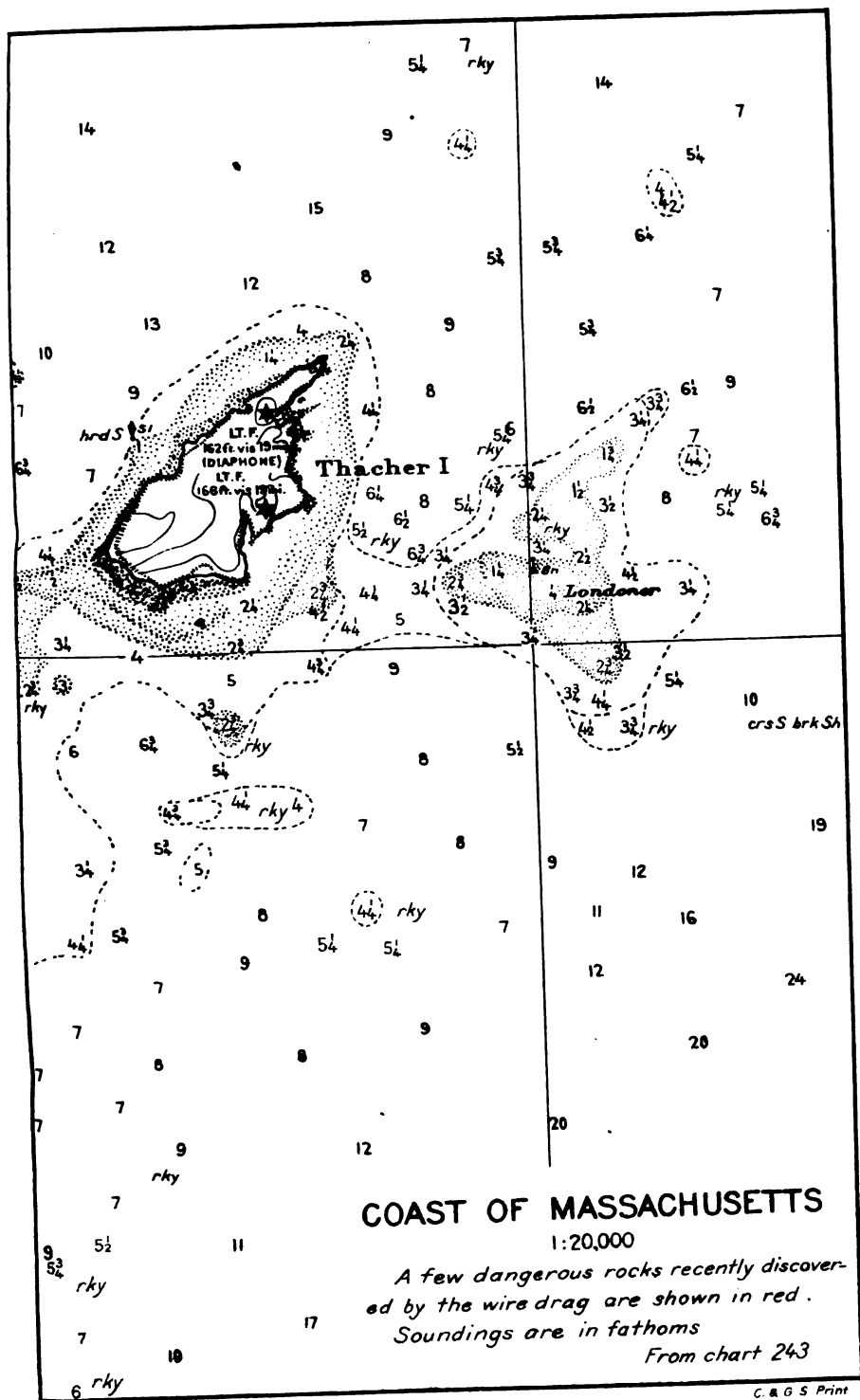


FIG. 10.

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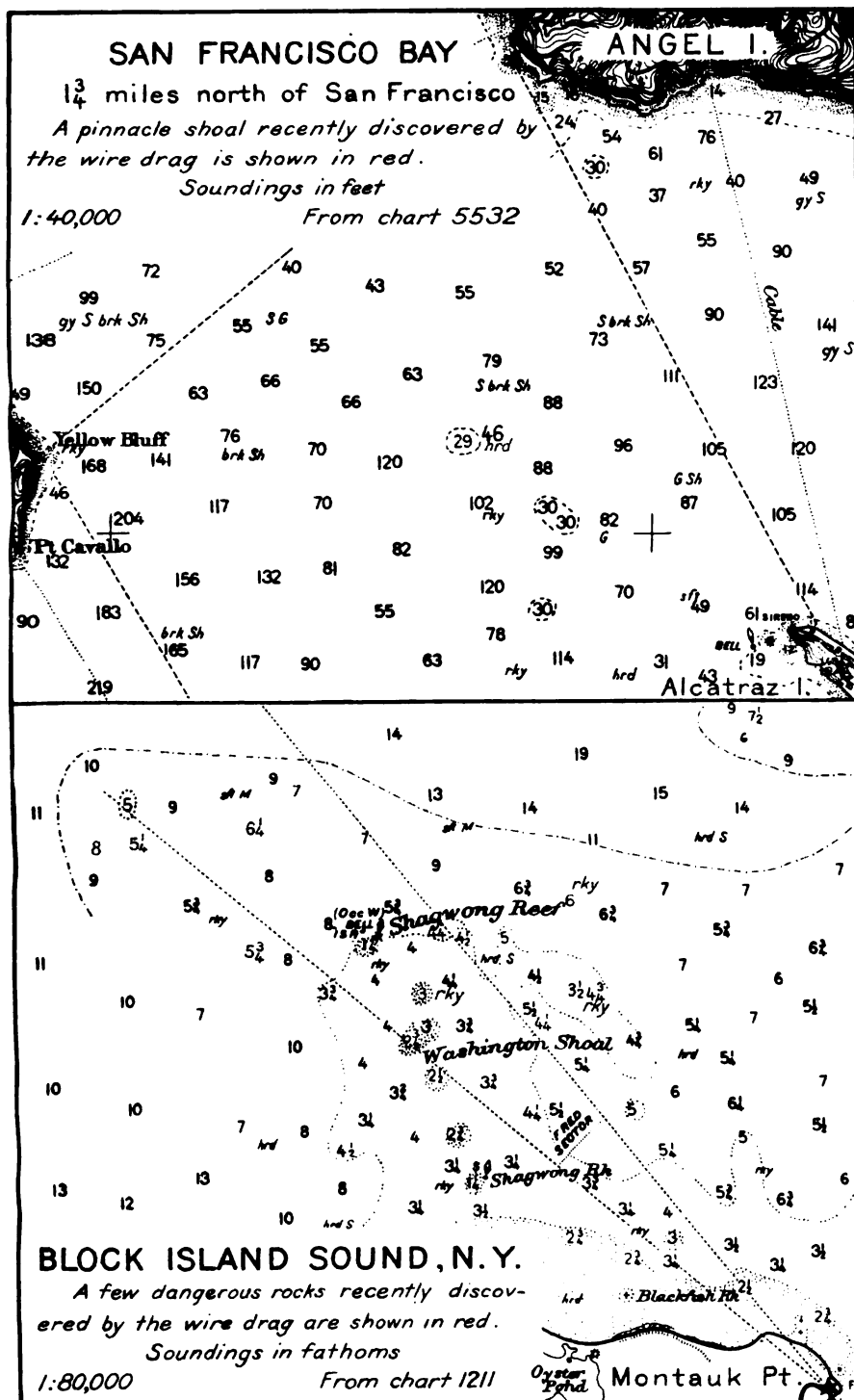


FIG. II.

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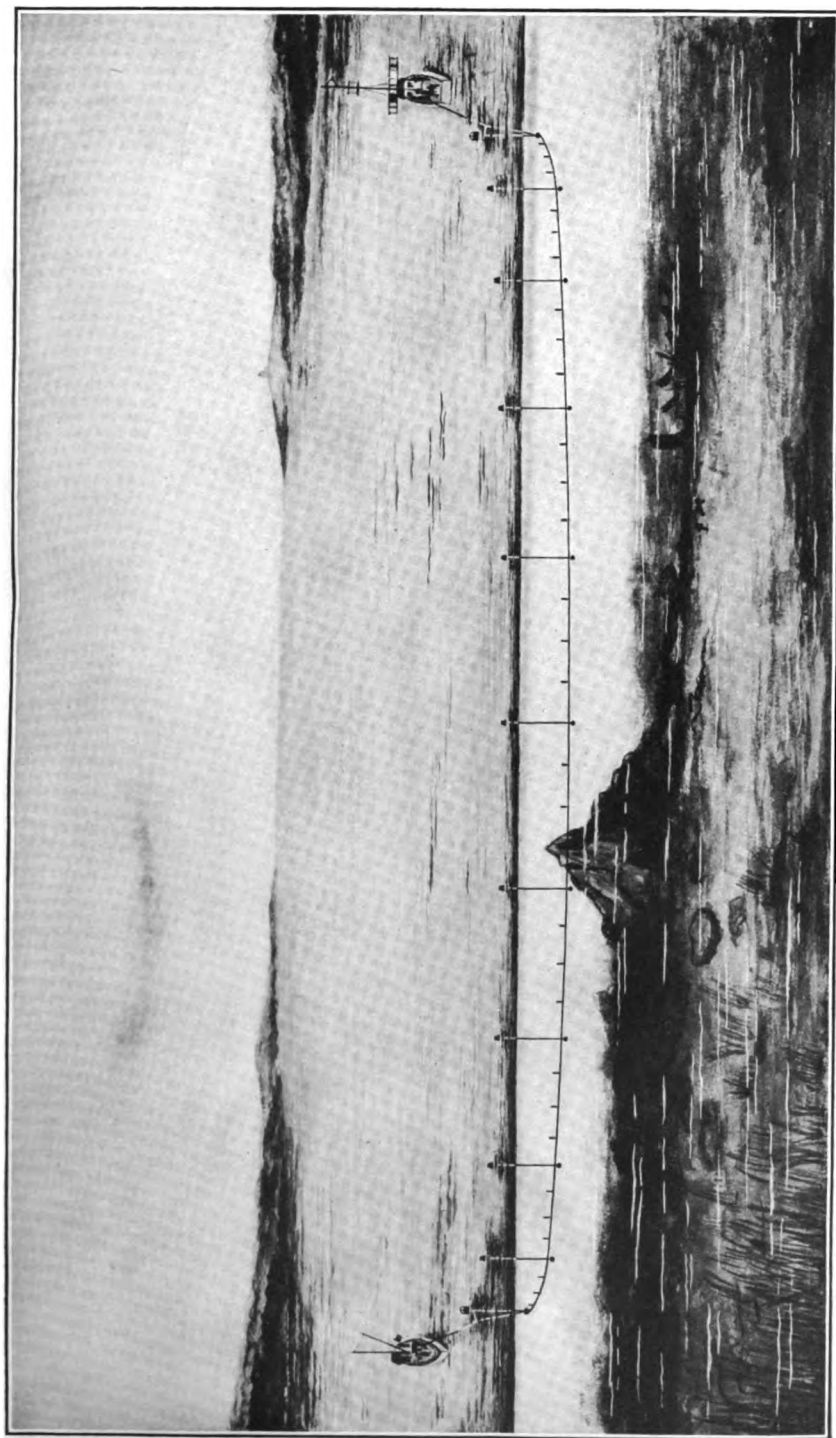


FIG. 13.—Wire drag in operation.

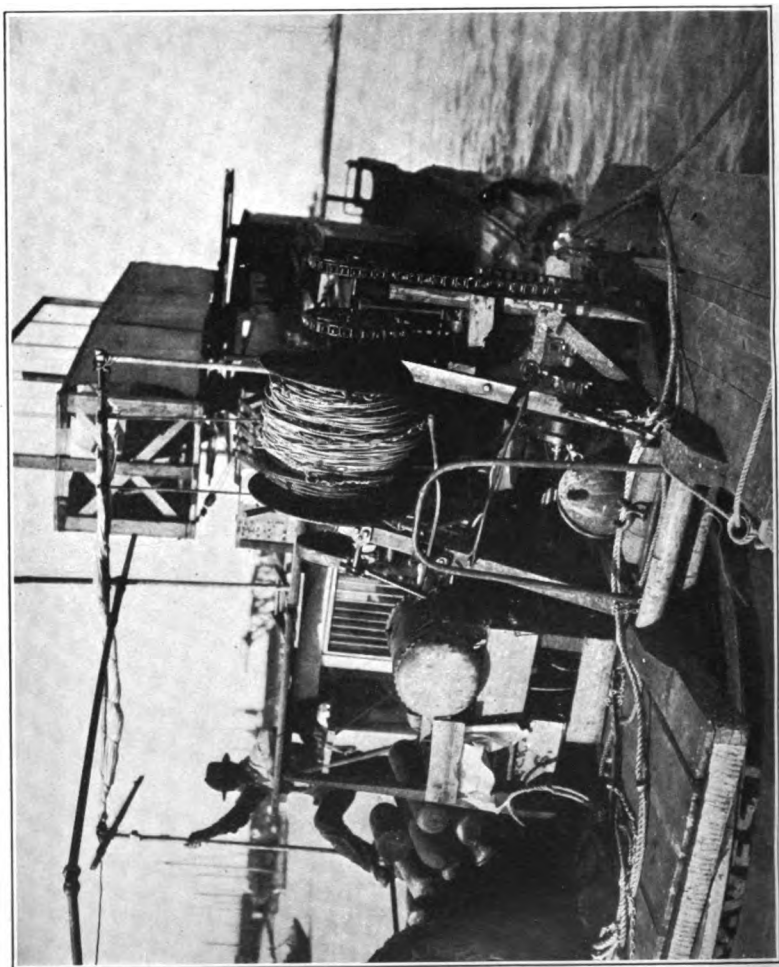


FIG. 15.—Wire-drag equipment installed on a rented launch.

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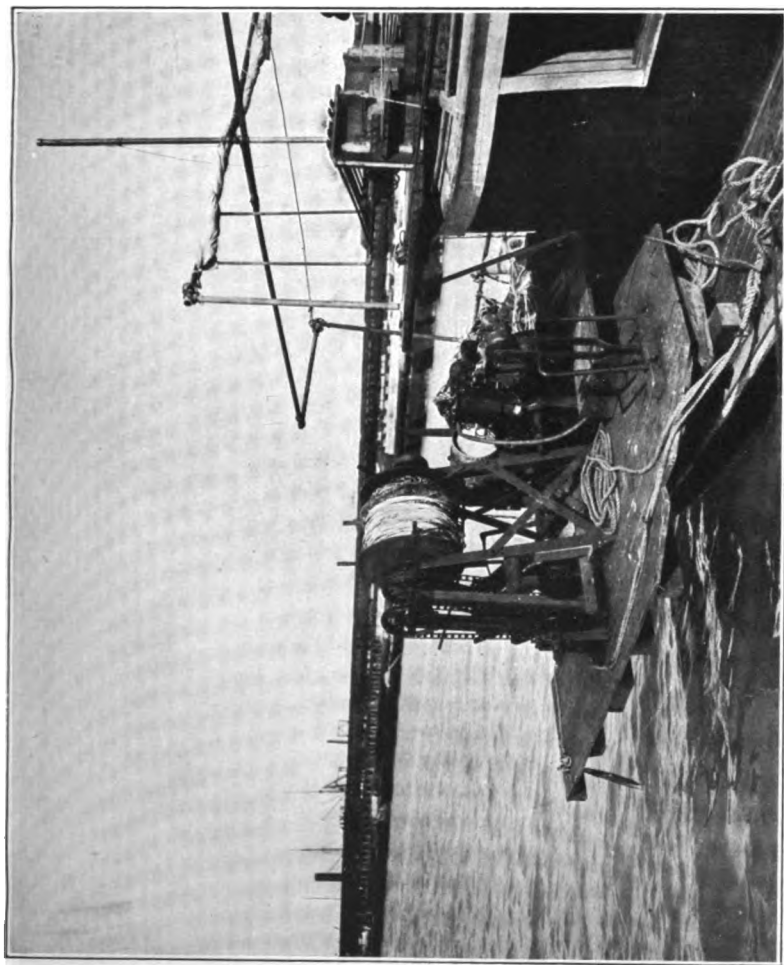


FIG. 16.—Wire-drag equipment installed on a rented launch.

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## Appendix E.—WAGES OF SEAMEN AND OFFICERS IN THE BUREAUS OF LIGHTHOUSES, COAST AND GEODETIC SURVEY, AND FISHERIES.

On page 62 of the report of which this forms a part, the agreement is described which was made between the representatives of the seamen and the employing ship-owners, with the knowledge and approval of the United States Shipping Board, the Secretary of Commerce, and the Secretary of Labor. This agreement was reached after the facts had been exhaustively discussed by the representatives of all sides concerned. It carries, therefore, the force normal to a result reached with all the facts known and maturely considered, not only by those directly interested in every phase of the subject but also by those whose sole interest was that of public officers seeking the general good.

Our merchant fleet has, since the agreement, been steadily operating under it without interruption or friction. The rates of wages stated in that agreement are the present standard rates on the Atlantic for the various employments concerned. For clearness they are here restated:

Sailors and firemen, \$60 per month; coal passers, \$50 per month; oilers and water tenders, \$65 per month; boatswains, \$70 per month; carpenters, \$75 per month. Overtime pay for cargo work, 50 cents, for ship work, 40 cents per hour; bonus going to the war zone 50 per cent of the wages, wages and bonus to continue until crew arrives back in the United States; \$100 compensation for loss of effects caused by war conditions. The scale of wages and bonus for cooks and stewards at present in force to be maintained and continued during the continuance of this agreement.

It is, of course, clear that for the marine work of the Lighthouse Service, the Coast and Geodetic Survey, and the Fisheries Service men who are merchant seamen can not be secured at wages much less than those which are paid for like duties or for less onerous duties in private employment of similar character. The fact is, however, that the wages fixed by law or limited by appropriations in these three services have been much lower than those current in the mercantile merchant service or in other Government services. This fact—for it is a fact and not a fancy, the figures are on record and can be accurately determined—has made it impossible in any of the three services mentioned of the Department of Commerce to maintain either in quantity or in quality the necessary crews for their vessels during the past fiscal year. This is emphasized here by pointing out that in the case of seamen in the Lighthouse Service it was necessary to employ 2,334 persons to fill 576 places, and in the case of second-class firemen 498 persons to fill 84 places. In the Coast and Geodetic Survey on the steamer *Patterson* on the Pacific coast, in a period of less than 8 months 132 persons were employed to fill 49 places. On the steamer *Isis*, of the same service, on the Atlantic coast 171 persons were employed to fill 44 places.

Furthermore the vessels have continuously been short handed and the crews have not been of the necessary quality. It is obvious such conditions can not continue. The work in each service is arduous and makes special demands upon seamen. The lighthouse vessels and those of the Coast and Geodetic Survey are obliged to go into dangerous places where no other vessels are supposed to go. The lighthouse crews must have special training in handling heavy buoys in rough water and in landing supplies under difficult conditions. The crews on the Coast and Geodetic Survey vessels have to assist in carrying on the actual work of the surveys. The men in the Fisheries Service must take part in the cultural operations of that Bureau. The law

makes no provision for special forces to do these special kinds of work. They are necessarily a part of the duty of the seamen of those services and are under ordinary conditions willingly and well performed. Conditions, however, are not ordinary. The present monthly pay of seamen in the coastwise services of the merchant marine on the Atlantic is double the former standard wage. The former standard rates of pay on vessels have been completely discarded and increases have been made in every grade, including officers and crews alike. No one needs to be told how the expense of living has increased. The facts are widely known to all. A readjustment of the Government rates of wages to existing conditions must be made in the services mentioned or else their vessels must be laid up when most needed or run with short and incompetent crews, though this last certainly means sooner or later the loss of one or more ships. The prevention of one such loss would far more than make good the necessary increase of wages to keep the ships well and properly manned.

#### Bureau of Lighthouses.

The greatest difficulty encountered in the maintenance of this Service during the past two years has been the matter of the pay of officers and crews on lighthouse tenders and light vessels. It is apparent from the experience of these two years that this Service can not cope with the existing conditions under appropriations which are based on abandoned and inadequate pay scales, no longer in use anywhere.

The following table gives the number of changes made in crews of lighthouse vessels during the fiscal year 1917:

	Author- ized.	Actually em- ployed.	Ratio of persons per position.
Quartermasters.....	104	328	3.2
Machinists.....	93	260	2.8
Seamen.....	576	2,334	4.1
Firemen, first class.....	187	789	4.2
Firemen, second class.....	84	498	5.9
Stewards.....	35	59	1.7
Cooks.....	114	325	2.8
Mess attendants.....	82	405	4.9
Total.....	1,275	4,999	3.9

The changes in senior officers have not been many, but those in junior positions, such as second officers and second assistant engineers of lighthouse tenders and mates and assistant engineers of light vessels, have been discouragingly numerous. For example, 81 persons filled 33 positions of junior deck officers, and 76 persons filled 33 positions of junior engineer officers, with corresponding ratios of men per position during the single fiscal year 1917 of 2.5 and 2.3, respectively. This condition is of serious importance to the future of the Service, as in the ordinary course of events these men would eventually be promoted to more responsible places, when the necessary experience in the manifold duties of the Service had been acquired.

Many deplorable situations have arisen in the past few years on account of insufficient pay; vessels have been tied up while urgent work waited, or have gone to sea undermanned or partly manned by incompetent and unfit persons at serious risk to life and property. Indeed, were it not for the commendable loyalty and fidelity to the Service displayed by the senior officers of these vessels, who have almost uniformly remained at their posts despite these discouraging circumstances, it is doubtful if the work accomplished could have been performed without some disaster to vessels of this Service, or to merchant vessels by reason of lighthouse work being omitted or improperly executed. As it is, the annual relief of buoys, a vital obligation of the Service, strictly required by its regulations, has been falling behind, and this condi-

tion will speedily become acute and dangerous if not remedied at an early date. For example, in the calendar year 1915 it was not possible to relieve 148 buoys; in 1916, the corresponding figure was 336; and in 1917 the number will probably be much larger.

The inconvenience of operating with insufficient crews and constantly changing personnel to whom the duties were new has been embarrassing to the Service, causing a serious handicap to efficient work, due to constantly breaking in green men of the low grade obtainable for the wages paid. By various makeshifts the vessels have been kept in commission except for relatively short periods, and have performed such work as possible with the number and character of men obtainable. It is estimated that the loss of time due to delay in obtaining men and doing the work with short crews has caused a decrease in efficiency as to amount of work done of at least 20 per cent during the past year, not taking into consideration the loss due to the inferior conditions in which vessels are maintained, or the hazard of attempting to proceed with dangerous duties short handed and with an inefficient force. As the total annual operating expense of light vessels is about \$1,750,000, the direct financial loss may be set at about \$350,000 during the fiscal year 1917. A most disturbing aspect as to the future is disclosed by recent inspections of vessels, which plainly show that a general deterioration in upkeep has been suffered during the past two years from this cause. There is no doubt that the employment of incompetent crews has caused a large loss to the Government, due wholly to the lower wages paid on lighthouse vessels as compared with the merchant marine.

The Department has been fully aware of these conditions, which are by no means confined to this Service, and which have been encountered with equal force by other maritime services of the Government. The matter has been given close attention, by the appointment of a departmental marine board to consider such problems, and in urging the necessity for greater appropriations. The 5 and 10 per cent increase authorized by Congress has of course been helpful but is quite insufficient to establish pay scales which will obtain the proper class of seafaring men.

In developing the detailed estimates prepared for submission to Congress, the figures have been based on the agreement already cited, which was the result of negotiations between the Department of Labor, the Department of Commerce, the Shipping Board, and representatives of both employees and employers, which fixed a wage scale to remain in force until a year after the war ends. The details of this agreement were published in the "Official Bulletin," issued by the Committee on Public Information on August 11, 1917, and have recently been applied to the Lighthouse Service by authority of the Department. It is therefore earnestly recommended that the estimate as submitted be enacted into law, in order that the work of the Service may be continuously and properly carried out.

#### Coast and Geodetic Survey.

This service has been unable to keep pace with the improved conditions of labor during recent years and in proportion as it has failed so to do its efficiency has been reduced. Service in the Coast and Geodetic Survey has been undesirable to the mariner because the pay has been less than he could earn elsewhere, either in the merchant marine or in industries ashore; the work is of more than average difficulty and must at times be continued through longer hours than the 8 to 10 to which the sailor is accustomed elsewhere; the living conditions in the crowded forecabin of the older wooden vessels are far from attractive; finally, the employment is only temporary and may be terminated at any time, so that he has not even the incentive of a permanent position to compensate him for other undesirable features.

The result of these conditions is that the Coast Survey has earned, among seafaring men, the reputation of an undesirable service. Men will come to it only as a last resort, when out of work, out of money, and with no chance to find employment in

other lines of work. This means that the Survey often gets the most undesirable type of men on the water front—not sailors, but misfits—those who in the process of selection have been refused other more desirable occupations. It would be an abuse of language and of an honorable profession to call them mariners.

Such men seldom remain long enough to become of value. When they have earned a few dollars they quit; if they can not obtain their discharge upon request, they either desert or by refusing duty, by drunkenness, and by general misconduct, compel the commanding officer to get rid of them.

The constant change and upheaval in the crews which results from these conditions is strikingly portrayed in the following table, which shows for each Coast Survey vessel in the United States waters the complement allowed and the number of persons in the complement during the fiscal year, 1917:

Vessel.	Station.	Normal complement.	Persons actually employed.
Surveyor.....	Atlantic coast.....	58	a 85
Beche.....	do.....	48	129
Isis.....	do.....	44	171
Matchless.....	do.....	16	54
Hydrographer.....	Gulf coast.....	18	51
Patterson.....	Pacific coast.....	49	b 132
Explorer.....	do.....	39	b 124

a In commission only since June 11, 1917.

b In commission only about seven to eight months of the year.

Even this table does not tell the whole, as every one of these vessels has been continuously short handed through inability to obtain recruits.

These factors, the undesirable type of men which alone can be obtained, and the inability to keep men even of this type, result in great waste.

1. The Coast Survey ships, as surveying units, are carefully planned, and their equipment and personnel are arranged so as to provide for the most effective operation of from three to five surveying parties. In these parties the sailors form an integral part. They are not there merely to man the ship; they take an active part in surveying work. They are the recorders, rodmen, leadsmen, tide observers, coxswains, or engineers of the surveying launches, operators of the sounding machines, etc. There are no idlers; each man (except the mess force) has his definite place in the organization, and the shortage of a single man means a loss in efficiency, and a shortage of three to five men means that one less party can be worked. This means that the efficiency of the vessel, measured by the amount of work done, is reduced from one-third to one-fifth.

It costs from \$30,000 to \$60,000 a year to operate each of these ships, depending on size and location; it follows that a shortage of a few men in the complement will result in a loss, measured by work left undone, of from \$6,000 to \$20,000 a year. In every such case the work left undone means needless risk to life and property and imposes indirectly a severe tax on commerce through excessive insurance.

2. Losses occur as the result of the lack of training of the men in the specialized work which they have to do. The sailors in the Coast Survey require training as much as the men in the Army or Navy. They do not merely shovel coal, scrub decks, or clean brass, or work the ship. They take an active part in the surveying operations, a part only less important than that of the officers, and no amount of efficiency on the part of the officers can compensate for the men's failure to do their work well. These are days of deep ships. Vessels must often pass close to the bottom, particularly along the Atlantic coast. The officers may properly find and locate channels or shoals, but if the leadsmen does not read the depths truly, if the recorder

does not record them rightly, if the tide observer goes to sleep or goes off somewhere for the day and then "fakes" the record of his staff readings, the result may be the loss of a vessel with lives and cargo through an error in the chart.

At least one full season's work is necessary to properly train these men in such duties. Yet the record above quoted shows that the complements change two or three times a year. Furthermore, the men which present conditions enable the Survey to obtain are, as a rule, of a type which has no desire to become proficient in the work. Their thoughts center on spending their pay, rather than on earning it fairly, so that too often their efforts are concentrated on doing the least amount of work that conditions and officers permit.

3. Losses occur from the effect of these conditions upon officers. Officers, who year after year are compelled to operate under such discouraging conditions, who are continually harassed by their inability to get good men or to enforce discipline over bad ones, and who have repeatedly appealed for relief without success, become disheartened and lose their enthusiasm. Inevitably, they tend finally to "take things easy," to humor the crews, to make concessions before an issue is forced. Their first thought is forced to be to so operate as to avoid a rupture which they are powerless to control rather than to concentrate effort on their work.

It must be clearly understood that these conditions are not merely the result of the present war. They existed in a serious degree before that conflict began; the war has merely exaggerated them to such an extent that it has already become necessary to lay up certain ships.

An effort has been made to compute the cost of these losses in efficiency, and from the best data available it appears that the loss by the seven vessels operating in the United States the past year is about \$82,000. One case, that of the *Patterson*, may be cited as typical.

The *Patterson* works in Alaska in summer and winters in Seattle. Last spring she was detained 20 days in Seattle through inability to obtain men. She finally sailed with a shortage of 5 men. After working for about 6 weeks with this reduced complement and its resultant loss, the ship was compelled to go to port. Here 5 days were lost through drunkenness among the crew and their refusal of duty. She finally got away with a shortage of 7 men. Efforts to recruit men in Seattle to fill these vacancies were unavailing; men would not even consider the \$60 they were offered when they could readily earn \$100 or over elsewhere.

Work was continued with this reduced complement, therefore, until early August, when the situation was relieved by stopping the work of another vessel, the *Explorer*, which had been operating under conditions equally bad. Enough men were kept aboard the *Explorer* to bring her to Seattle, where she was laid up; the remainder were transferred to the *Patterson*.

The estimated cost of this decreased efficiency on the *Patterson* alone is \$24,500.

All possible means have been used by the Coast and Geodetic Survey to improve these conditions. The pay of the crews has been necessarily increased to an amount considerably beyond that available under the existing appropriation. The fact that some officers and vessels of the Survey have been taken over by the Navy relieves the situation; otherwise, it would have been necessary either to obtain a deficiency appropriation from Congress, or to lay up more of the ships in the spring of 1918.

For this situation there are two possible remedies, one partial and one complete.

The partial remedy is to allow the present status of the crews to remain unchanged, employing them for the duration of the season and paying them a wage as high or slightly higher than they would obtain elsewhere.

This plan, in a modified form, has already been adopted by the Bureau, and in the 1919 estimates the fund for pay of crews is based on the wage scale recently adopted for the governmental and private merchant fleets by representatives of the Depart-



ment of Commerce, the Department of Labor, the Shipping Board, employers, and employees.

There are, however, a number of reasons why this increase in wages will not completely solve the problem under consideration.

1. The equality in wages is only apparent, for the earnings of merchant seamen are materially increased by overtime pay, which it is impracticable to grant employees in the Coast and Geodetic Survey.

2. The Survey vessels, working near ports, must compete not only with the merchant marine, but also with the labor markets ashore. These latter are glad to pay \$75 to \$100 per month for the men to whom the Survey can offer only \$60.

3. Employing men for the season only, even if they could be induced to remain for that period, will not afford a complete solution. As has already been shown, the maximum effectiveness in the work of the Survey can be obtained only with trained crews. It requires a season to train these men; and under the above plan they would be discharged just when they were beginning to be effective, and the following season the same training process would be begun anew.

The truth is that increased pay is only one element entering into the final solution of the problem. That solution rests on a complete readjustment of present conditions.

The men must eventually be given permanent employment at a just wage and under comfortable living conditions. They must have before them the prospect of advancement both in rank and pay for faithful service, and their rights must be fully safeguarded. In return, they must be required to live up to the terms of an equitable contract, and there must be authority for dealing effectively with the occasional undesirable who refuses to do so.

Such a readjustment will make it possible to build a permanent organization of sober, industrious men, devoted to the Survey and its interests through long association, and will result in an increase of 20 to 25 per cent in the efficiency of every vessel.

#### **Bureau of Fisheries.**

The outstanding fact in the Bureau of Fisheries is that on eight vessels three distinct systems exist as regards officers and crews. On five vessels specific crews are required with statutory wages. A larger seagoing steamer, the *Roosevelt*, has a lump-sum appropriation for her officers and crew; two other seagoing steamers, the *Albatross* and *Fish Hawk*, are officered and manned by the Navy. This condition is inconsistent, anomalous, not conducive to efficient and economical administration, and is unsatisfactory to the personnel on account of the different rates of pay for similar services.

Better results could be obtained if the vessel service were reorganized on a logical, systematic basis with uniform pay for like grades on all vessels, commensurate with those in similar Government establishments and in the merchant marine, with reasonable opportunities for promotion. There should also be a certain elasticity in the organization, so that the crews of a given vessel may be increased or decreased as needs may require; in other words, when a slack time comes for a certain vessel, there should be opportunity to use her complement or its equivalent on others which may be actively engaged.

An organization similar to that of the Coast Survey would, with some modifications to suit the Bureau's special needs, permit the attainment of the desired results, and a lump-sum appropriation should be provided for the wages and subsistence of a corps of officers and men sufficient for all the larger vessels of the Bureau. Ratings, grades, pay, and normal complements for each boat should be established by departmental order and the officers be appointed by the Secretary in accordance with civil-service rules, while the men should be regularly enlisted by the several vessel masters, under proper and adequate regulations. A saving can be made to the Government by substituting civilian for Navy crews for the *Albatross* and *Fish Hawk*, and recommendations to that effect have been made to Congress. (See Report for 1916, p. 9, and

Report for 1915, p. 11.) It is not considered advisable to press the matter during the present national crisis, as the vessels in question are on naval duty.

On its vessels which are provided with statutory places the Bureau has met in a degree with the same difficulties in maintaining suitable and sufficient crews that have confronted the other marine bureaus of the Department, and these difficulties will continue as the commercial rates of pay advance. The situation was somewhat ameliorated by the allowing of subsistence, which went into effect in 1916, and it has been possible to keep the smaller vessels in commission without very serious delays. However, out of 31 places there have been 19 changes in two years. A better class of men is needed than ordinary deck hands, for they are called on to act as spawn takers, to distribute fishes, make egg collections, and for other fish-cultural duties. They often assist in minor capacities in technical investigations.

The appropriation for officers and crew of the *Roosevelt*, originally based on commercial wages then prevailing, is now entirely inadequate, and will only suffice for seven and a half months. When the vessel sailed from Norfolk for Seattle in January, 1917, it was necessary to materially increase the wages of her crew in order to obtain men, and a further increase was found necessary when a crew was shipped in Seattle for the Alaska service. At the same time the compensation of officers was raised barely enough to equalize it in a measure with that of the merchant marine and other bureaus of the Department.

Unless the appropriation is increased by \$10,000, it will be necessary to lay the *Roosevelt* up for a third of each year. The important work of the vessel will be seriously handicapped, and the problem of transporting supplies to the Pribilof Islands and maintaining a fisheries patrol will be difficult to meet. For the present year the only alternative is a deficiency appropriation.

The present law authorizing commutation of rations limits the amount per man to 50 cents a day, and experience has shown that this is entirely inadequate, owing to the greatly advanced cost of provisions. It will be recommended that the law be changed so that the Secretary of Commerce may establish the rates, as is done in other bureaus of the Department.



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**REPORTS**  
**OF THE**  
**DEPARTMENT OF COMMERCE**

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**BUREAU OF FOREIGN AND DOMESTIC  
COMMERCE  
BUREAU OF STANDARDS  
BUREAU OF THE CENSUS  
BUREAU OF FISHERIES  
BUREAU OF LIGHTHOUSES**

**COAST AND GEODETIC SURVEY  
STEAMBOAT-INSPECTION SERVICE  
BUREAU OF NAVIGATION  
APPOINTMENT DIVISION  
DIVISION OF PUBLICATIONS**



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**REPORT**  
**OF THE**  
**CHIEF OF BUREAU OF FOREIGN AND DOMESTIC**  
**COMMERCE**

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# **REPORT**

OF THE

## **CHIEF, BUREAU OF FOREIGN AND DOMESTIC COMMERCE.**

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DEPARTMENT OF COMMERCE,  
BUREAU OF FOREIGN AND DOMESTIC COMMERCE,  
*Washington, October 15, 1917.*

SIR: I have the honor to transmit herewith, as Chief of the Bureau of Foreign and Domestic Commerce, the annual report of the Bureau for the fiscal year ending June 30, 1917.

Insomuch as during the entire year my predecessor was chief of the Bureau, the accomplishments of that term should be credited largely to the vigorous policies established by him. In submitting my first annual report, I desire to express my admiration for the excellent features of organization which were put into effect by Mr. A. H. Baldwin and Dr. E. E. Pratt, my two predecessors in office.

As a practical manufacturer and exporter, I entertained to a mild extent an instinctive skepticism regarding the efficiency in organization and productive capacity of a Government bureau as compared with the highly organized forces characteristic of large private enterprises, for this is a feeling all too common among business men. I find that a misapprehension of the value of the Bureau is based on a typical ignorance of the Bureau's current activities. Please let me emphasize the conviction that the Bureau of Foreign and Domestic Commerce is a genuinely producing agency, well organized, and calculated to assist our manufacturers and merchants in ways eminently useful.

I expect that the present year will see us engaged in efforts to make the Bureau not only a source of reliable data on all commercial subjects but also the headquarters of a commercial activity extending into every foreign field for the benefit of our country's industries.

### **REVIEW OF THE YEAR'S FOREIGN TRADE.**

The event of transcending importance to the foreign trade of the country during the fiscal year 1917 was the entrance of the United States into the war.

From the beginning of the war to the time of our entrance into it the business of the American manufacturer and exporter was to sell munitions and supplies to the belligerents, to make the most of new opportunities in the markets of nonbelligerent countries, and to take

wise and needful steps in preparation for trade after the war. These were legitimate and profitable activities. They were vital to the industrial life of the Nation. But when we entered the war the perspective changed. Trade with our war associates assumed a new, a different, a much greater significance in our eyes. It became primarily a means of winning the war rather than of winning profits. It became a link between the greatest storehouse in the world and the European nations with whom we had cast our lot in the world struggle.

Our attitude toward the markets in nonbelligerent countries has also changed as a matter of course. Trade with them must now be conducted with a careful and patriotic deference to the successful prosecution of the war. Preparations that we make to hold our place in those markets and to expand our opportunities must be made for the time being with strict reference to policies which govern our political relations. However, it is confidently expected that our trade with South America, the Far East, South Africa, and with Australia will not be too seriously interfered with and that we may reap in the future the benefits of having cultivated those markets so assiduously and intelligently during the past few years.

Important as it is that we hold our own advantage in these and other markets, we must not lose sight of the fact that all such advantages are likely to disappear if we do not come out of the war victoriously.

#### NEW RECORDS IN FOREIGN TRADE.

The fiscal year 1917 was our greatest year in foreign trade. The total of our transactions with foreign countries is unprecedented in the history of this or any other country. Merchandise exported and imported was valued at \$8,953,000,000, a notable gain even when compared with \$6,531,000,000 of the previous year. It has more than doubled the highest figure ever recorded in normal times.

The principal gain was in exports, which were valued at \$6,294,000,000, as against \$4,333,000,000 in 1916. Before the war our monthly exports averaged around \$200,000,000; in 1915 the average was about \$230,000,000; in 1916 it had risen to \$361,000,000, and in 1917 the average monthly value of exports was no less than \$524,000,000. The greatest month in the history of our export trade was January, 1917, when our sales abroad amounted to \$613,000,000.

Imports also increased in a notable manner in 1917, for the total value of foreign merchandise brought into this country was \$2,660,000,000, an increase of more than \$460,000,000 over 1916, the former record year. Except England, no country has ever imported merchandise at this rate. In normal times our imports averaged about \$150,000,000 a month, but in 1917 the average rose to \$221,000,000. In June, the closing month of the fiscal year, a total of \$306,000,000 worth of foreign products were brought into the country.

We exported \$3,634,000,000 more than we imported in 1917. This increase in excess of exports amounted to 70 per cent as compared with 1916 and 232 per cent as compared with 1915. The significance of these figures will be better realized if it is borne in mind that the balance of trade in our favor in the 20 years before the war amounted to somewhat less than \$450,000,000 a year.

American imports and exports of merchandise are shown, month by month, from July, 1913, to June, 1917, in the following table:

IMPORTS AND EXPORTS OF MERCHANDISE INTO AND FROM THE UNITED STATES,  
JULY, 1913, TO JUNE, 1917, BY MONTHS.

Month.	Imports.	Exports.	Excess of—	
			Imports.	Exports.
1913.				
July.....	\$139,061,770	\$160,990,778		\$21,928,008
August.....	137,651,553	187,909,020		50,257,467
September.....	171,084,843	218,240,001		47,155,158
October.....	132,949,302	271,861,464		138,912,162
November.....	148,236,536	245,539,042		97,302,506
December.....	184,025,571	232,195,628		49,170,057
1914.				
January.....	154,742,923	204,066,003		49,323,080
February.....	148,044,776	173,920,145		25,875,369
March.....	182,555,304	187,499,234		4,943,930
April.....	173,762,114	162,562,570	\$11,209,544	
May.....	164,281,515	161,732,619	2,548,896	
June.....	157,529,450	157,072,044	457,406	
Total, 12 months.....	1,893,925,657	2,364,579,148		470,653,491
1915.				
July.....	159,677,261	154,138,947	5,538,314	
August.....	129,767,890	110,367,494	19,400,396	
September.....	139,710,611	156,052,333		16,341,722
October.....	138,080,520	194,711,170		56,630,650
November.....	126,467,062	205,878,333		79,411,271
December.....	114,656,545	245,632,558		130,976,013
1916.				
January.....	122,148,317	267,879,313		145,730,996
February.....	125,123,391	299,808,899		174,685,478
March.....	157,982,016	296,611,852		138,629,836
April.....	160,576,106	294,745,913		134,169,807
May.....	142,284,851	274,218,142		131,933,291
June.....	157,685,140	268,547,416		110,862,276
Total, 12 months.....	1,674,169,740	2,768,589,340		1,094,419,600
1917.				
July.....	143,244,737	268,468,702		125,223,965
August.....	141,804,202	260,609,995		118,805,793
September.....	151,236,026	300,654,921		149,418,895
October.....	149,172,739	336,152,009		186,979,269
November.....	155,496,675	327,670,333		172,173,678
December.....	171,832,505	359,306,362		187,473,857
1918.				
January.....	184,350,942	330,036,410		145,685,468
February.....	198,935,117	401,783,974		202,848,857
March.....	213,589,785	410,742,084		197,152,299
April.....	218,236,397	398,568,532		180,332,135
May.....	226,188,957	474,803,637		248,614,680
June.....	245,795,438	464,085,956		218,290,518
Total, 12 months.....	2,197,883,510	4,333,482,885		2,135,599,375
1919.				
July.....	182,722,938	444,713,964		261,991,026
August.....	199,316,490	510,167,438		310,850,948
September.....	164,088,614	514,924,134		350,835,520
October.....	178,658,730	492,813,918		314,155,188
November.....	176,967,749	516,167,324		339,199,575
December.....	204,834,188	522,232,780		318,399,592
1920.				
January.....	241,793,282	612,324,582		371,531,300
February.....	199,479,996	467,048,406		267,568,410
March.....	270,267,120	553,985,099		283,717,979
April.....	253,935,966	529,927,815		275,991,849
May.....	280,727,164	551,088,981		270,361,817
June.....	306,622,939	575,210,049		268,587,110
Total, 12 months.....	2,659,355,185	6,298,806,080		3,634,440,904

## THE GOLD MOVEMENT.

The increase in our exports during the last three years and the favorable balance of trade to our credit has had the effect of reversing the position which this country has heretofore occupied in the financial world. We have become a creditor instead of a debtor nation, and the settling of our balance, without unduly disturbing the international exchange rate, is engaging the serious attention of the bankers of this and other countries. Obviously for a great commercial nation to continue to export double the amount of goods it buys would upset the international balance of trade to such an extent as to make it impossible for the foreign countries receiving the goods to pay for them. Under the circumstances, any credit arrangements must be temporary, for settlement must be made sooner or later. This may be effected by rendering service in international sales or transportation or by remitting gold.

In partial settlement of this favorable balance the United States received shipments of gold amounting to \$172,000,000 in 1915, \$495,000,000 in 1916, and \$977,000,000 in 1917, a total of \$1,643,000,000 in three years, principally from England, either direct or through Canada. The exports of gold from the United States amounted to \$146,000,000 in 1915, \$90,000,000 in 1916, and \$292,000,000 in 1917, a total of \$528,000,000. For the three years since the beginning of the war, therefore, the net imports of gold have amounted to \$1,115,000,000.

The movement of gold can be traced month by month since the beginning of the war in the following table:

IMPORTS AND EXPORTS OF GOLD INTO AND FROM THE UNITED STATES DURING THE FISCAL YEARS ENDED JUNE 30, 1914 TO 1917, BY MONTHS.

Month.	Imports.	Exports.	Excess of—	
			Imports.	Exports.
1913.				
July.....	\$7,859,512	\$8,653,969		\$794,457
August.....	5,803,753	1,194,657	\$4,609,096	
September.....	4,626,748	496,037	4,130,711	
October.....	5,391,085	483,780	4,907,305	
November.....	7,040,782	6,662,958	377,824	
December.....	5,073,357	10,572,593		5,499,236
1914.				
January.....	10,442,373	6,914,056	3,528,317	
February.....	3,208,853	9,078,778		5,869,925
March.....	7,842,249	2,632,049	5,210,200	
April.....	3,460,424	407,386	3,053,038	
May.....	1,972,411	16,835,202		14,862,791
June.....	3,817,112	48,107,064		44,289,952
Total, 12 months.....	66,538,659	112,038,529		45,499,870
1915.				
July.....	3,391,715	33,660,424		30,277,709
August.....	3,045,219	18,125,617		15,080,398
September.....	2,761,590	21,887,202		19,125,612
October.....	5,945,003	50,301,972		44,356,969
November.....	7,391,729	14,526,482		7,134,753
December.....	4,109,063	130,924	3,978,139	
1916.				
January.....	6,896,398	691,509	6,204,889	
February.....	12,726,492	1,053,879	11,672,613	
March.....	26,620,467	923,891	24,696,576	

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## IMPORTS AND EXPORTS OF GOLD INTO AND FROM THE UNITED STATES DURING THE FISCAL YEARS ENDED JUNE 30, 1914 TO 1917, BY MONTHS—Continued.

Month.	Imports.	Exports.	Excess of—	
			Imports.	Exports.
1915.				
April.....	\$16,203,028	\$813,706	\$15,389,322	
May.....	31,136,311	1,277,554	29,858,757	
June.....	52,341,740	2,821,988	49,519,752	
Total, 12 months.....	171,668,755	146,224,148	25,344,607	
July.....	17,262,938	2,191,735	15,071,203	
August.....	61,641,191	1,128,428	60,512,763	
September.....	42,082,449	2,033,990	40,028,459	
October.....	79,669,359	2,638,800	76,730,559	
November.....	60,981,540	3,661,153	57,320,387	
December.....	45,412,677	11,889,285	33,523,392	
1916.				
January.....	15,008,232	10,213,517	4,794,715	
February.....	6,016,006	13,684,667		\$7,668,661
March.....	9,776,439	10,774,354		997,915
April.....	6,121,788	11,502,999		5,381,211
May.....	27,321,943	11,918,597	15,403,346	
June.....	122,734,739	8,312,023	114,422,716	
Total, 12 months.....	494,009,301	90,249,548	403,759,753	
July.....	62,107,666	9,395,035	52,712,630	
August.....	41,238,716	11,780,129	29,458,587	
September.....	92,562,247	6,849,141	85,713,106	
October.....	97,508,875	7,053,684	90,455,191	
November.....	46,972,903	26,335,062	20,637,841	
December.....	158,620,681	27,973,719	130,646,962	
1917.				
January.....	58,926,258	20,719,898	38,206,360	
February.....	103,766,496	22,068,069	81,698,426	
March.....	139,498,590	17,919,601	121,578,989	
April.....	32,372,455	16,865,210	15,407,245	
May.....	52,262,090	57,087,419		5,435,329
June.....	91,339,051	67,164,268	24,174,783	
Total, 12 months.....	977,176,026	291,921,225	685,254,801	

In addition to sending us gold and more imports our foreign customers have paid for merchandise by selling back to us American securities held abroad. We have also invested millions in foreign securities and Government loans. Our own Government has made loans to the allied Governments of Europe amounting to over \$2,250,000,000. Three years ago the suggestion that the United States would soon be a creditor nation received scant respect either here or abroad. Now speculation is turning on our future rank among creditor nations.

As a result of our large imports of gold we have accumulated stocks amounting to about one-third of the total gold supply of the world. It is generally conceded that it is undesirable to continue this drain on the gold reserves of other countries. For the most part their financial systems are based upon gold, and a continued loss of the metal will naturally result in weakening their credit and destroying their buying power.

### INCREASED EXPORTS OF MANUFACTURED GOODS.

A most interesting feature of the export trade for 1917 is the great gain in the sales of completed manufactures; \$2,944,000,000 worth

of such products were shipped in 1917 as compared with approximately \$2,000,000,000 in 1916 and \$725,000,000 worth in the normal year 1914. In 1914 this group formed 31 per cent of the total domestic exports, while in 1916 and 1917 it formed 47 per cent of the total. Among the principal articles of this group are the following: Brass manufactures, the sales of which amounted to \$4,000,000 in 1914, \$128,000,000 in 1916, and \$260,000,000 in 1917; automobiles and parts, exports of which increased from \$33,000,000 in 1914 to \$120,000,000 in 1916 and \$118,000,000 in 1917; miscellaneous chemicals, disinfectants, and surgical dressings, exports of which rose from \$9,000,000 in 1914 to \$56,000,000 in 1916 and \$76,000,000 in 1917; cotton cloth and wearing apparel, which sold to the extent of \$40,000,000 in 1914, \$81,000,000 in 1916, and \$104,000,000 in 1917; cartridges, gunpowder, and high explosives, which jumped from a mere \$6,000,000 in 1914 to \$467,000,000 in 1916 and reached the enormous total of \$803,000,000 in 1917; firearms, the foreign sales of which totaled \$3,000,000 in 1914, \$18,000,000 in 1916, and \$95,000,000 in 1917; locomotives and metal-working and other machinery, which show a substantial if not sensational increase from \$116,000,000 in 1914 to \$183,000,000 in 1916 and \$262,000,000 in 1917; wire and wire manufactures, which rose from \$10,000,000 in 1914 to \$48,000,000 in 1916 and \$58,000,000 in 1917; boots and shoes, harness, saddles, and other manufactures of leather, exported to the extent of \$21,000,000 in 1914, \$67,000,000 in 1916, and \$45,000,000 in 1917; blankets, wearing apparel, and other manufactures of wool, the exports of which amounted to \$4,000,000 in 1914, \$53,000,000 in 1916, and \$17,000,000 in 1917.

There was a striking increase of nearly 100 per cent in the exports of manufactures for further use in manufacturing in 1917 as compared with 1916. The total exports of such products during the last fiscal year were valued at \$1,192,000,000, as contrasted with \$658,000,000 in 1916 and \$374,000,000 in the more normal year 1914. Among the principal items in this group are brass bars, plates, and sheets, the exports of which increased from less than \$1,000,000 in 1914 to \$36,000,000 in 1916 and \$121,000,000 in 1917. The exports of sulphuric and other acids increased from less than \$1,000,000 in 1914 to \$25,000,000 in 1916 and \$56,000,000 in 1917. Shipments of steel ingots, billets, and bars amounted to \$8,000,000 in 1914 and increased to \$80,000,000 in 1916 and \$201,000,000 in 1917. Exports of tinplates increased from \$4,000,000 in 1914 to \$19,000,000 in 1916 and \$28,000,000 in 1917. The sales of leather to foreign countries increased from \$37,000,000 in 1914 to \$80,000,000 in 1916 and \$109,000,000 in 1917.

It is an interesting fact that the war has not stimulated the exports of crude materials for use in manufacturing. We have needed more raw materials at home and the shipping situation has not been conducive to increased ocean shipment of low-value commodities. Foreign sales of such materials in 1917 were valued at \$732,000,000, an important increase, it is true, when compared with the \$556,000,000 in 1916 and the \$510,000,000 in 1915, but a figure that is still below the total of \$793,000,000 recorded for 1914. The decrease in 1915 and 1916 as compared with 1914 occurred principally in raw cotton, the exports of which were valued at \$610,000,000 in 1914, \$376,000,000 in 1915, and \$374,000,000 in 1916. The value of raw cotton exports in 1917 shows a recovery to \$543,000,000. The exports of foodstuffs in crude

condition, consisting largely of grain, have, of course, increased at a rapid rate, the total for 1917 being placed at \$532,000,000 as against \$381,000,000 in 1916 and \$137,000,000 in 1914. Exports of domestic foodstuffs partly or wholly prepared have also increased rapidly, the total for 1917 being \$739,000,000; for 1916, \$599,000,000; and for 1914, \$293,000,000.

#### INCREASED IMPORTS OF RAW MATERIALS.

In our import trade the tendency to increase our purchase of crude materials and decrease our purchase of finished manufactures is in striking contrast to the tendency noticed in our export trade. Our receipts of foreign crude materials for use in manufacturing amounted to not less than \$1,110,000,000 in 1917 as against \$949,000,000 in 1916 and \$634,000,000 in 1914. This group includes hides; india rubber and gums; raw fibers, silk, and wool; antimony, copper, lead, nickel, sulphur, and other ores; cedar, mahogany, and other cabinet woods. These articles are imported largely from tropical and subtropical countries and do not compete with home products. The unprecedented increase in importations of this kind is another reflection of industrial activity in the United States.

The imports of articles classed as foodstuffs in crude condition amounted to \$336,000,000 in 1917, \$252,000,000 in 1916, and \$248,000,000 in 1914. They formed 13 per cent of the total imports in 1917, a percentage which has varied very little during the last 20 years. This group consists largely of tropical products, such as cocoa beans, coffee, fruits, unshelled nuts, unground spices, and tea.

The imports of partly or wholly prepared foodstuffs were valued at \$343,000,000 in 1917, against \$311,000,000 in 1916 and \$228,000,000 in 1914. Such imports comprised 13 per cent of the total in 1917, or slightly more than the yearly average for the last decade. This group includes rice and other breadstuff preparations, cured fish, prepared fruits, shelled nuts, meats, cheese, olive oil, distilled liquors, wines, sugar, and molasses.

A much more noticeable increase has taken place in the imports of articles partly manufactured for further use in manufacturing, the total for 1917 being \$475,000,000, as contrasted with \$357,000,000 in 1916 and \$320,000,000 in 1914. This group includes aluminum, antimony, brass, copper, tin, and other metals further advanced than the ore; argols, chicle gum, tanning extracts, nitrate of soda, and other chemicals; cotton, flax, and silk yarn; palm and other vegetable oils for soap making; lumber and wood pulp.

The total of \$380,000,000 worth of completed manufactures imported in 1917 was an increase of \$68,000,000 over 1916 but a decrease of \$69,000,000 when compared with the normal year 1914. Such imports formed 24 per cent of the total in 1914 but only 14 per cent in 1916 and 1917. Included in this group are cotton, linen, silk and wool cloths, laces, stockings, underwear, and other wearing apparel; cutlery, machinery, and other manufactures of iron and steel; leather, gloves, paper, toys, and cigars; shingles, furniture, and other manufactures of wood. These articles are subject to relatively high rates of duty, and the decreased importations since the war account to a large extent for the decrease in customs receipts, which fell off 23 per cent in 1917 as compared with 1914.



Imports into the United States, classified by great groups according to use and degree of manufacture, during the fiscal years 1914, 1916, and 1917 are shown in the following table:

Great groups.	1914		1916		1917	
	Value.	Per ct.	Value.	Per ct.	Value.	Per ct.
Crude materials for use in manufacturing.....	\$632,865,860	33.42	\$648,825,500	43.17	\$1,109,665,040	41.73
Foodstuffs in crude condition, and food animals.....	247,947,621	13.09	251,886,746	11.46	335,573,042	12.62
Foodstuffs partly or wholly manufactured.....	227,644,329	12.02	310,988,181	14.14	343,474,387	12.91
Manufactures for further use in manufacturing.....	319,275,488	16.86	356,857,137	16.24	475,325,346	17.87
Manufactures ready for consumption.....	449,318,214	23.72	311,870,962	14.19	379,662,329	14.28
Miscellaneous.....	16,874,145	.89	17,504,984	.80	15,655,041	.59
Total imports of merchandise.....	1,893,925,657	100.00	2,197,883,510	100.00	2,659,355,185	100.00

Domestic exports from the United States, classified by great groups according to use and degree of manufacture, during the fiscal years 1914, 1916, and 1917 are shown in the following table:

Great groups.	1914		1916		1917	
	Value.	Per ct.	Value.	Per ct.	Value.	Per ct.
Crude materials for use in manufacturing.....	\$792,716,109	34.03	\$535,952,043	12.55	\$732,388,652	11.75
Foodstuffs in crude condition, and food animals.....	137,495,121	5.90	380,638,102	8.91	532,017,562	8.54
Foodstuffs partly or wholly manufactured.....	293,218,336	12.59	599,059,151	14.02	739,037,884	11.86
Manufactures for further use in manufacturing.....	874,224,210	16.06	657,923,305	15.40	1,191,787,957	19.13
Manufactures ready for consumption.....	724,908,000	31.11	1,998,298,249	46.77	2,943,923,212	47.25
Miscellaneous.....	7,122,249	.31	100,306,729	2.35	91,613,998	1.47
Total domestic goods.....	2,329,684,025	100.00	4,272,177,579	100.00	6,230,769,295	100.00
Export of foreign goods.....	34,896,123	.....	61,305,306	.....	63,036,795	.....
Total exports.....	2,364,579,148	.....	4,333,482,885	.....	6,293,806,090	.....

#### EXPORTS BY GRAND DIVISIONS AND COUNTRIES.

By far the largest part of our export trade has always been with Europe. In 1914 nearly 63 per cent of our exports were sent to that continent, and this proportion increased to over 69 per cent in 1916 and amounted to nearly 69 per cent in 1917. Much of our exports to Europe during the last two or three years has been army supplies and foodstuffs, and it is to be expected that when peace is made there will be a falling off in our sales of such lines as ammunition and firearms, horses and mules, corn and oats, automobiles and aeroplanes, and copper, lead, and zinc manufactures. On the other hand, it is probable that the demand by European countries, especially Belgium, France, and Russia, for building material, machinery, railway equipment, and other construction and reconstruction material will be larger than it has been during the war. Our total exports to Europe were valued at \$1,486,000,000 in 1914 and \$4,325,000,000 in 1917, an increase of \$2,839,000,000, or 191 per cent.

Aside from the growth in exports to Europe, our exports to South and Central America, Australia, and the Far East, as well as to Africa, show a considerable increase. Much of this new business is expected to be permanent, especially in view of our increased pur-

chases of raw materials and foodstuffs from these countries, of which we are buying a ever-increasing share and for which we are sending them in exchange finished manufactured products.

Our exports to North American countries increased from \$529,000,000 in 1914 to \$1,164,000,000 in 1917, a gain of 120 per cent. Shipments to South America more than doubled during the same period, rising from \$125,000,000 in 1914 to \$260,000,000 in 1917, a gain of 108 per cent. Exports to Asia increased more than three-fold, from \$113,000,000 to \$380,000,000, an increase of 236 per cent. Exports to Oceania and Africa do not show as great a gain proportionately as in the case of the other grand divisions of the world, our sales to Oceania having increased from \$84,000,000 to \$111,000,000, or 33 per cent, and to Africa from \$28,000,000 in 1914 to \$53,000,000 in 1917, an increase of 90 per cent.

Of the increase of \$2,839,000,000 in our exports to Europe in the last three years, by far the greater part went to the United Kingdom, the totals being \$594,000,000 in 1914 and \$2,048,000,000 in 1917. Exports to France increased from \$160,000,000 to \$1,012,000,000; to Italy, from \$74,000,000 to \$361,000,000; and to Russia in Europe, from \$30,000,000 in 1914 to \$428,000,000 in 1917. Exports to the neutral countries of Europe increased generally, with the exception of the Netherlands. Sales to Denmark increased from \$16,000,000 to \$57,000,000; to Norway, from \$9,000,000 to \$82,000,000; to Spain, from \$30,000,000 to \$77,000,000; to Sweden, from \$15,000,000 to \$45,000,000; and to Switzerland, from \$1,000,000 in 1914 to \$22,000,000 in 1917. Exports to the Netherlands increased from \$112,000,000 in 1914 to \$143,000,000 in 1915 but decreased to \$97,000,000 in 1916 and amounted to \$110,000,000 in 1917.

Exports to Belgium dropped from \$61,000,000 to \$37,000,000; to Germany from \$345,000,000 to \$2,000,000; and to Austria-Hungary from \$23,000,000 in 1914 to nothing in 1917.

The largest part of the \$636,000,000 increase in exports to North America occurred in the trade with Canada, which increased from \$345,000,000 in 1914 to \$788,000,000 in 1917. Exports to Cuba increased from \$69,000,000 to \$179,000,000; to Mexico, from \$39,000,000 in 1914 to \$79,000,000 in 1917; and somewhat smaller increases are shown in the trade with Central America and the West Indies.

Our exports more than doubled in the last three years to every country in South America with the exception of Argentina and Brazil, which, however, show an increase of nearly 100 per cent in 1917 over 1914, Argentina from \$45,000,000 to \$82,000,000, and Brazil from \$30,000,000 to \$57,000,000.

The high rate of increase in exports to Asia, 235 per cent in the last three years, is principally accounted for by the increased exports to Russia in Asia, which rose from \$1,000,000 in 1914 to \$130,000,000 in 1917. These shipments include large amounts of war supplies and railroad material shipped from the Pacific ports through Vladivostok. Exports to Japan increased from \$51,000,000 to \$130,000,000, and to the British East Indies from \$16,000,000 in 1914 to \$37,000,000 in 1917.

The increase of \$27,000,000 in exports to Oceania occurred entirely in exports to Australia and New Zealand, which increased from \$55,000,000 in 1914 to \$82,000,000 in 1917. Shipments to British Africa increased from \$19,000,000 in 1914 to \$33,000,000 in 1917.

The total exports, by grand divisions and principal countries, during the fiscal years 1913 to 1917, inclusive, are shown in the table following:

**TOTAL VALUES OF EXPORTS OF MERCHANDISE, BY PRINCIPAL COUNTRIES AND GRAND DIVISIONS, DURING THE FISCAL YEARS ENDED JUNE 30, 1913 TO 1917.**

Countries.	1913	1914	1915	1916	1917
<b>Europe:</b>					
Austria-Hungary.....	\$23,320,696	\$22,718,258	\$1,238,069	\$146,302	
Belgium.....	66,845,462	61,219,894	20,662,315	21,648,114	\$37,348,319
Denmark.....	18,687,794	15,670,135	79,824,478	55,872,312	50,728,524
France.....	146,100,201	159,818,924	369,397,170	628,851,988	1,011,520,006
Germany.....	\$31,684,212	344,794,276	28,863,354	288,899	2,199,449
Italy.....	76,285,278	74,235,012	184,819,688	269,246,108	360,520,626
Netherlands.....	125,909,882	112,215,673	143,267,019	97,476,328	109,504,109
Norway.....	8,391,458	9,066,610	39,074,701	53,645,295	82,017,054
Russia in Europe.....	25,363,795	30,088,643	37,474,380	178,094,800	428,284,663
Spain.....	31,471,723	30,387,539	38,112,989	52,530,721	76,999,689
Sweden.....	12,104,366	14,644,226	78,273,818	51,970,745	45,116,443
Switzerland.....	8,285,549	1,019,602	2,735,788	8,082,516	22,826,779
United Kingdom.....	597,149,059	594,271,833	911,794,954	1,526,685,102	2,047,545,843
Other Europe.....	14,934,306	16,348,044	35,895,384	53,650,870	45,322,168
<b>North America:</b>					
Canada.....	415,449,457	344,716,981	300,686,812	468,784,793	787,529,729
Central America.....	40,220,282	39,439,117	33,585,728	41,708,906	52,728,324
Mexico.....	54,383,424	38,748,793	34,164,447	47,945,519	78,659,893
British West Indies.....	12,811,156	13,357,010	11,879,591	16,230,039	21,844,201
Cuba.....	70,581,154	68,884,428	75,530,382	127,198,578	178,883,248
Other North America.....	23,967,540	23,498,633	21,228,767	31,161,839	44,805,789
<b>South America:</b>					
Argentina.....	52,894,834	45,179,089	32,549,606	66,378,366	82,382,894
Brazil.....	42,638,467	29,963,914	25,639,555	40,572,197	56,761,222
Chile.....	16,076,763	17,432,392	11,377,181	24,239,826	44,578,185
Colombia.....	7,397,096	6,786,153	6,675,564	11,666,932	14,906,786
Peru.....	7,341,903	7,141,252	5,873,474	9,526,230	18,885,174
Uruguay.....	7,522,145	5,641,266	5,171,323	10,287,384	14,292,125
Venezuela.....	5,737,118	5,401,380	5,764,442	9,088,998	12,885,222
Other South America.....	6,539,067	6,994,457	6,282,812	8,415,441	14,872,890
<b>Asia:</b>					
China.....	21,326,834	24,098,734	16,402,475	25,181,459	37,806,388
East Indies (British).....	15,108,966	15,625,195	15,980,724	24,696,872	37,090,430
Japan.....	57,741,815	51,205,520	41,517,780	74,470,981	180,472,189
Russia in Asia.....	1,101,419	1,214,506	23,363,151	181,111,792	120,800,642
Other Asia.....	19,777,596	20,681,661	17,216,353	23,199,827	45,151,169
<b>Oceania:</b>					
Australia and New Zealand.....	52,431,352	54,725,340	51,986,649	74,002,526	82,043,469
Philippine Islands.....	25,884,768	27,304,587	24,755,820	28,421,178	27,548,476
Other Oceania.....	1,286,700	1,538,490	1,022,760	1,352,130	1,696,195
<b>Africa:</b>					
British Africa.....	18,852,009	18,960,770	18,271,065	28,399,877	32,695,101
Other Africa.....	10,236,908	8,940,745	10,248,666	15,191,654	20,051,766
<b>Total.....</b>	<b>2,465,884,149</b>	<b>2,364,579,148</b>	<b>2,768,589,340</b>	<b>4,333,482,885</b>	<b>6,293,806,090</b>
<b>RECAPITULATION.</b>					
Europe.....	1,479,074,761	1,496,496,729	1,971,434,067	2,999,305,097	4,325,443,736
North America.....	617,413,013	528,644,962	477,075,727	733,024,674	1,164,451,184
South America.....	146,147,963	124,539,909	99,323,957	180,175,374	299,559,452
Asia.....	115,066,620	113,425,616	114,470,468	278,610,881	380,320,718
Oceania.....	79,102,845	83,508,417	77,764,725	98,775,828	111,284,128
Africa.....	29,088,917	27,901,515	28,519,751	43,591,081	52,746,967

**IMPORTS BY GRAND DIVISIONS AND COUNTRIES.**

A study of the countries and geographical sections of the world from which our imports are obtained shows some important changes in 1917 compared with former years. There has been a pronounced tendency to buy direct from the original source of supply instead of through middlemen as heretofore.

For the first time in our history Europe, which has held first place in selling goods to the United States, declined to second place. North

America took first place. In 1914 the imports from Europe were valued at \$896,000,000, or 47½ per cent of the total, while the imports from North America were \$427,000,000, or 22½ per cent of the total. In 1916 imports from Europe were 28 per cent of the total and those from North America 27 per cent. Of the total imports of \$2,659,000,000 in 1917, \$610,000,000, or 23 per cent, were from Europe, and \$766,000,000, or 28½ per cent, from North America. In 1917 the imports from Europe showed a decrease of \$285,000,000 from the figures for 1914, and the imports from North America showed an increase of \$339,000,000, a gain of 80 per cent for North America against a loss of 32 per cent for Europe.

The imports of German goods decreased \$188,000,000 in 1917 against 1914, amounting to \$190,000,000 in 1914 and \$2,000,000 in 1917. Other decreases shown in the imports are: From Austria-Hungary from \$20,000,000 in 1914 to less than \$250,000 in 1917; Belgium, from \$41,000,000 in 1914 to \$1,000,000 in 1917; France, from \$141,000,000 in 1914 to \$108,000,000 in 1917; Italy, from \$56,000,000 in 1914 to \$46,000,000 in 1917; Russia in Europe from \$21,000,000 in 1914 to \$5,000,000 in 1917; Switzerland, from \$25,000,000 in 1914 to \$20,000,000 in 1917; and Turkey in Europe from \$8,000,000 in 1914 to \$20,000 in 1917.

Increases are shown in imports from Greece, from \$4,000,000 in 1914 to over \$7,000,000 in 1917; Portugal, from \$6,000,000 in 1914 to \$9,000,000 in 1917; Spain, from \$25,000,000 in 1914 to \$37,000,000 in 1917; Sweden, from \$12,000,000 in 1914 to \$24,000,000 in 1917; and the United Kingdom, from \$294,000,000 in 1914 to \$308,000,000 in 1917.

Of the increase in imports from North America of nearly \$340,000,000, Canada shared to the extent of \$160,000,000, having sold to us goods valued at \$321,000,000 in 1917 against \$161,000,000 in 1914; Mexico shared to the extent of \$19,000,000, its shipments being valued at \$93,000,000 in 1914 and \$112,000,000 in 1917. Imports from Cuba increased by \$122,000,000 in the last three years, having amounted to \$131,000,000 in 1914 against \$253,000,000 in 1917. This increase is chiefly due to the rise in the value of sugar from \$98,000,000 in 1914 to \$205,000,000 in 1917, although the quantity decreased from 4,900,000,000 pounds to 4,660,000,000 pounds in the same period.

Imports from South America and Asia in 1917 show a gain of more than 100 per cent over 1914, the increase from South America being 143 per cent and from Asia 114 per cent.

Imports from South America increased from \$223,000,000 in 1914 to \$392,000,000 in 1916, and \$542,000,000 in 1917. Our purchases from Argentina increased from \$45,000,000 in 1914 to \$153,000,000 in 1917; from Brazil, \$101,000,000 in 1914 to \$151,000,000 in 1917, an increase of \$50,000,000; from Chile, \$26,000,000 in 1914 to \$114,000,000 in 1917; from Peru, \$12,000,000 in 1914 to \$36,000,000 in 1917; and from Uruguay, \$8,000,000 in 1914 to \$30,000,000 in 1917. Lesser increases are shown in other South American countries.

Imports from Asia were valued at \$287,000,000 in 1914, \$437,000,000 in 1916, and \$615,000,000 in 1917. The largest increase occurred in the imports from Japan, which increased from \$107,000,000 in 1914 to \$208,000,000 in 1917. The next largest gain was made in imports from China, which increased from \$39,000,000 in

1914 to \$106,000,000 in 1917. Shipments from the Dutch East Indies increased from \$5,000,000 in 1914 to \$62,000,000 in 1917. Imports from British India and Straits Settlements increased from \$100,000,000 in 1914 to \$192,000,000 in 1917. The imports from Turkey in Asia decreased from \$12,500,000 in 1914 to \$300,000 in 1917.

Imports from Oceania in 1917 show a decrease from 1916 but an increase over 1914, amounting to \$42,000,000 in 1914, \$96,000,000 in 1916, and \$65,000,000 in 1917. Imports from the Philippine Islands amounted to \$18,000,000 in 1914, \$28,000,000 in 1916, and \$42,000,000 in 1917. Our purchases from Australia and New Zealand, which amounted to \$22,000,000 in 1914, rose to \$64,000,000 in 1916 but decreased to \$19,000,000 in 1917.

African imports in 1917 gained 213 per cent over 1914. They amounted to only \$19,000,000 in 1914 as against \$65,000,000 in 1916 and \$60,000,000 in 1917. Imports from British Africa increased from \$4,000,000 in 1914 to \$25,000,000 in 1917, and Egypt from \$13,000,000 in 1914 to \$30,000,000 in 1917. The gain of nearly \$17,000,000 from Egypt was practically all in raw cotton, the value of which was \$12,000,000 in 1914 and \$28,000,000 in 1917.

The highest rates of increase are in imports from the tropical and subtropical countries which produce raw materials used in our factories, such as hides, india rubber, gums, hemp, jute, manila, sisal, raw silk, raw wool, and other textile fibers, for the supply of which we depend largely or entirely on foreign countries.

Total values of imports, by principal countries and grand divisions, from 1913 to 1917 are shown in the table following:

TOTAL VALUES OF IMPORTS OF MERCHANDISE INTO THE UNITED STATES, BY PRINCIPAL COUNTRIES AND GRAND DIVISIONS, DURING THE FISCAL YEARS ENDED JUNE 30. 1913 TO 1917.

Countries.	1913	1914	1915	1916	1917
<b>Europe:</b>					
Austria-Hungary.....	\$19,192,414	\$20,110,834	\$9,794,418	\$1,430,935	\$225,452
Belgium.....	41,941,014	41,035,532	10,222,960	1,478,579	1,029,261
France.....	136,877,990	141,446,252	77,158,740	102,077,620	108,069,706
Germany.....	188,963,071	189,919,136	91,372,710	13,945,743	1,524,063
Italy.....	54,107,364	56,407,671	54,973,726	57,432,436	46,374,368
Netherlands.....	38,180,967	36,294,010	32,518,890	38,534,509	31,842,144
Norway.....	8,418,359	9,197,265	10,668,864	6,851,714	7,108,311
Russia in Europe.....	26,958,690	20,831,184	2,512,381	3,613,986	5,446,066
Spain.....	23,220,012	24,658,867	18,027,492	27,864,130	36,862,571
Sweden.....	11,174,419	11,590,107	11,661,337	11,846,881	23,642,433
Switzerland.....	25,260,180	25,329,669	19,385,483	21,775,413	20,262,964
United Kingdom.....	295,564,940	293,661,304	256,351,675	308,443,223	307,674,858
Other Europe.....	25,006,964	25,121,007	19,756,069	20,957,580	20,417,829
<b>North America:</b>					
Canada.....	120,571,180	160,689,709	159,571,712	204,018,227	320,949,492
Central America.....	16,449,824	17,842,591	21,234,665	26,899,607	35,968,674
Mexico.....	77,543,842	92,690,566	77,612,691	97,676,544	112,138,677
British West Indies.....	12,644,362	15,550,859	13,252,362	14,404,754	16,759,466
Cuba.....	126,088,173	131,303,794	185,708,901	228,977,567	263,395,410
Other North America.....	8,646,278	9,321,835	15,701,465	20,918,844	26,882,618
<b>South America:</b>					
Argentina.....	26,963,732	45,123,988	73,776,258	112,512,420	152,612,411
Brazil.....	120,155,856	101,329,073	99,178,728	132,663,984	161,638,245
Chile.....	27,655,420	25,722,128	27,689,780	64,154,869	113,789,120
Colombia.....	15,979,912	16,051,120	18,953,023	21,458,029	28,965,920
Peru.....	9,696,579	12,175,723	12,596,648	24,326,689	26,379,016
Uruguay.....	2,450,697	7,715,144	10,492,649	14,475,478	20,406,533
Venezuela.....	10,852,331	9,763,069	13,227,238	14,942,448	15,018,567
Other South America.....	4,110,103	4,796,830	5,575,239	7,026,111	13,402,999
<b>Asia:</b>					
China.....	39,010,800	39,382,978	40,156,139	71,655,045	105,905,581
Each Indies (British).....	116,220,591	111,903,527	87,177,237	177,423,346	217,610,066
Japan.....	91,632,240	107,355,897	98,882,638	147,844,226	205,137,478
Other Asia.....	29,630,146	28,310,084	21,554,069	40,458,845	83,574,396

## TOTAL VALUES OF IMPORTS OF MERCHANDISE INTO THE UNITED STATES, BY PRINCIPAL COUNTRIES AND GRAND DIVISIONS, ETC.—Continued.

Countries.	1913	1914	1915	1916	1917
<b>Oceania:</b>					
Australia and New Zealand.....	\$15,341,362	\$22,213,570	\$27,244,039	\$64,553,441	\$18,874,871
Philippine Islands.....	21,010,248	18,162,312	24,020,169	28,232,249	42,436,247
Other Oceania.....	1,191,831	1,768,516	1,258,344	3,440,301	4,017,661
<b>Africa:</b>					
British Africa.....	4,334,339	3,956,581	6,090,857	26,759,970	25,293,667
Egypt.....	19,907,828	13,311,233	17,371,992	33,254,943	29,728,445
Other Africa.....	2,183,177	1,881,662	1,490,232	4,750,532	4,991,204
<b>Total.....</b>	<b>1,813,008,234</b>	<b>1,893,925,657</b>	<b>1,674,169,740</b>	<b>2,197,883,510</b>	<b>2,669,365,186</b>
<b>RECAPITULATION.</b>					
Europe.....	892,866,384	395,602,868	614,354,645	616,252,749	610,470,670
North America.....	361,943,659	427,399,354	473,079,796	591,995,543	766,112,537
South America.....	217,734,629	222,677,375	261,489,563	391,582,018	542,212,820
Asia.....	276,494,777	286,952,486	247,770,103	437,181,464	615,217,463
Oceania.....	37,543,441	42,144,398	52,522,552	96,225,991	65,828,379
Africa.....	26,425,344	19,149,476	24,953,081	64,765,745	60,013,316

## EFFECT OF HIGHER PRICES ON TOTAL VALUES.

The large increases in the total values of imports and exports since the war represent in only a few cases a corresponding increase in the quantities of articles imported and exported. In a large proportion of articles the prices in 1917 were much higher than in 1914, the last year before the war, and the increases in quantities were in many instances proportionately less than the increases in values. This is strikingly shown in the increases in the average export prices of leading articles. The export values are based on the value stated in the export declaration furnished by the shipper and are intended to represent the market value of the articles at the time and place of exportation. The average export price of corn was 75 cents per bushel in 1914 and \$1.12 in 1917; wheat more than doubled in price, from 95 cents to practically \$2 per bushel; flour increased from \$4.61 to \$7.80 per barrel; copper ingots and pigs, mostly refined copper, from a little less than 15 cents per pound in 1914 to over 28 cents in 1917; upland raw cotton, from less than 13 cents to more than 18 cents per pound; sole leather, from less than 26 cents to more than 43 cents per pound; bacon and hams, from 13 cents to 18 cents per pound; lard, from 11 cents to 17 cents per pound; salted or pickled pork, from less than 11 cents to nearly 15 cents per pound; pickled beef, from less than 10 cents to nearly 12 cents per pound; butter, from about 24 cents to nearly 33 cents; and cheese from 17 cents to 23 cents per pound; cottonseed oil, exported principally for use in the manufacture of oleomargarine, increased from 7 cents to over 12 cents per pound; and sugar from \$3.60 per hundred pounds in 1914 to \$6.20 per hundred pounds in 1917. Corresponding increases in average export prices are shown in a large number of other articles, including binder twine, wire nails, steel rails, tin plates, and barbed and other wire.

That higher prices are not confined to the United States but are general throughout the world is proved by the increases in the prices of imported articles, the values of which are in all cases based on the wholesale prices in the principal markets of the foreign countries

from which they are shipped to the United States. Copper ingots and bars, principally unrefined, increased from 14 cents per pound in 1914 to 26 cents in 1917; manila hemp, from \$197 to \$225 per ton; india rubber (crude) from 54 cents to nearly 57 cents per pound; goatskins doubled in price, from 26 cents to 52 cents per pound; cattle hides, from less than 19 cents to 26 cents per pound; raw silk, from \$3.42 to \$4.61 per pound; and clothing wool from 25 cents in 1914 to 36 cents per pound in 1917. The average import price of cane sugar in 1917 is more than double the price in 1914, having risen from 2 cents per pound to 4½ cents per pound. Large increases in the average import prices are also shown for cocoa beans, raw cotton and flax; pig iron, manganese ore, tungsten ore, and other metals.

#### NEW AND OLD ACTIVITIES OF THE BUREAU.

As was the case with many another Government bureau, the work performed during the fiscal year 1917 by the Bureau of Foreign and Domestic Commerce was of two kinds—that comprising our customary activities and that resulting from the entrance of the United States into the war.

Ordinarily the Bureau is concerned with the sale of American goods, especially abroad, and with statistical and other studies of trade tendencies and practice. For the greater part of 1917 its energies were directed along these familiar lines, with this important difference, however, as compared with previous years, that the difficulties encountered were much greater than ever before because of the abnormal increase in our foreign business, because of inadequate shipping facilities to districts outside the fighting zone and because of the complicated restrictions placed upon neutral commerce.

Appropriations did permit an increase in the staff in one important direction—the corps of special agents employed to investigate commercial conditions of various specialized lines in particular countries. At the beginning of the fiscal year there were 13 agents on the Bureau's rolls; at the end of the year there were 26. Almost without exception, the efforts of this staff were directed to the regions lying well outside the areas of hostilities, for it was felt that the abnormal business with the belligerents would take care of itself, whereas the business with other districts, being of the utmost importance to the future of our industries, but not so spectacular and alluring, needed cultivation.

The other members of the staff redoubled their efforts along their usual lines of activity. The commercial attachés quickened their efforts to promote American trade, made more than the usual number of important reports, and in some cases visited this country to give the manufacturer and exporter the benefit of personal interviews. The district and cooperative offices made it a point to get into closer touch with the firms in their districts. The Washington office distributed more printed reports, attended to more correspondence, and conferred with more seekers after commercial information than ever before in its history. Quarters became inadequate, and it was necessary to put desks and chairs for visitors in the corridors.

With the declaration of war against Germany, the Bureau, under the direction of the Secretary of Commerce, at once set to work

upon novel and important tasks connected with the Government's plans for prosecuting the war. It was neither desirable nor possible to drop the ordinary work of the Bureau, and the staff was once more asked to take over additional work and handle it as best it could. In this case, however, a great deal of valuable assistance was rendered by experienced business men who came to Washington and volunteered their help as their contribution to the common cause of winning the war.

#### ORGANIZATION FOR LICENSING EXPORTS.

Most important of the new undertakings was the organization of a division to license exports. When the United States entered the war it was essential that our export trade should be so controlled as to husband our own supplies, utilize the available tonnage to the best advantage, and make it impossible for American supplies to reach the enemy. There was some question as to which branch of the Government would be selected to initiate this important work, and it was realized that eventually special war-work organizations might be brought into being to devote exclusive attention to the task, following the example of other belligerent countries. As it was imperative, however, that the necessary preliminary steps be taken immediately, the Secretary of Commerce directed that the Bureau of Foreign and Domestic Commerce to proceed with the organization of the required staff at once. The Bureau officials were familiar with the experiences of other countries along the same lines and felt confident that an organization familiar with foreign trade would be successful in the administration of export regulation. A careful study was made of the war regulation of export trade as carried on by the allied Governments. Pertinent and valuable information was obtained from sections of the allied missions that came to this country.

When the espionage act was passed, therefore, and the licensing was, for the time being at least, entrusted to the Bureau, plans for the organization of the new division were already completed and part of the staff actually at work, thanks for the most part to the fine spirit that had brought a number of practical American export men and economists to Washington as volunteers. All the preliminary work had been accomplished through hard work by the regular staff, assisted by the volunteers, who, with no special appropriation to draw upon, depended upon the regular Bureau funds to cover the entire expense. The Bureau willingly taxed its energies and funds to the utmost.

A feature of the licensing organization was the war trade intelligence section, which was designed to collect information as to the character of shippers and consignees. Another subdivision was the war trade statistical section, the duties of which were to consist broadly in analyzing the effects of the war on the currents of international trade. A corps of trade experts was planned, each member of which was to be an experienced man in the export trade and in some particular line, or to have a knowledge of the foreign trade of some one country or district. There were also an administrative office, registry, balance, and issuing sections, a correspondence section, an accounts section, a printing and supplies section, a mails and files section, and a miscellaneous section.



A division of this size naturally required many clerks and stenographers, and these were supplied as rapidly as possible by the Civil Service Commission. For a few weeks the new employees were crowded into the Commerce Building, which has been overburdened from the beginning. It was soon necessary to rent another building and put it into shape to accommodate the rapidly increasing staff.

The district offices of the Bureau were called on for help in licensing exports. Although it was out of the question to organize expert staffs for each office capable of passing on the doubtful applications for licenses, it was felt that a great deal of time could be saved by having the district offices pass upon the many applications concerning which there was no possible question. The difficult and delicate questions that are bound to arise in connection with a licensing program of this sort must, in the nature of things, be passed upon at the headquarters of the organization. From the beginning it was held proper that the district offices receive applications in their districts and obtain decisions from Washington with the least possible delay. All this, of course, meant an immense amount of extra work for the offices early in the new fiscal year, but the preparations to meet such an emergency were begun with the cheerful spirit and confidence that insure success.

With the appearance of the President's proclamation appointing a definite embargo date for certain commodities, the Bureau was well prepared to go ahead with the labor of issuing export licenses covering the important products shipped from American ports. The organization and the administration of export control was thought to be appropriately placed in the Bureau, because the Bureau's main concern has always been to promote and foster commerce, and it therefore was in its natural place as a protector of the country's trade. The commercial forces on all sides felt confident that the Bureau would act as a sympathetic administrator of a measure that was necessarily severe for the time being.

#### TRADING WITH THE ENEMY LEGISLATION.

The task of drafting legislation and regulations to limit trading with the enemy fell in part to the Department of Commerce, working with the Department of State and the Department of Justice. The Bureau, with its experience in foreign trade and its knowledge of the steps taken along the same lines by European Governments, was able to contribute materially to this work. The Bureau was likewise able to assist in planning an organization capable of administering the trading with the enemy act when passed. A plan of organization and the various forms that would be necessary under the act were mapped out. This preliminary work, done under pressure, has been of real importance and will be of still greater importance when the time comes to enforce the act, if the Bureau is invited to act as an adviser. From its close contact with manufacturers, merchants, and financial institutions, the Bureau was, moreover, able to give expert and friendly counsel on the matters relating to the administration of enemy property within the United States.

## DIVISION OF COST ACCOUNTING.

During the year the Bureau took over the work of encouraging scientific cost accounting among American manufacturers that the Federal Trade Commission had initiated. Circumstances, however, soon made it advisable to put aside temporarily the routine features of the work and concentrate upon assisting the Government purchasing officers and Government suppliers interested in costs in connection with war contracts. A conference of representatives from the various departments was called immediately, therefore, and an outline of the proposed scope of the division was announced. According to this outline the work planned was as follows: (1) To establish a consultation service on costs and to assist in any way such departments as may be interested in costs; (2) to arrange meetings with manufacturers interested in Government contracts on the cost-plus-profit plan and to explain to them the methods to be followed in presenting their costs to the Government; (3) to carry on the educational work formerly conducted by the Federal Trade Commission.

The formation of an interdepartmental cost conference, under the direction of the Secretary of Commerce and the Assistant Chief of the Bureau, was then undertaken. Represented in this conference were the Department of Commerce, the War Department, Navy Department, Food Commission, the Council of National Defense, and the Federal Trade Commission. For the first time in the history of any Government this conference invited the comptrollers of the country's leading business concerns to appear at the meeting and express their views. These conferences were called to collaborate in the preparation of a manual on cost methods and contract forms covering all contractual relations in Government purchases.

The division of cost accounting was put in charge of an expert, approved by the American Institute of Accountants, who was provided with a staff of five assistants. The importance of scientific cost methods can not well be overstated, it is recognized by every progressive manufacturer in the country, and was very graphically emphasized by Mr. E. N. Hurley while he was a member of the Federal Trade Commission.

## OPPORTUNE REPORT ON GERMAN TRADE METHODS AND MARKETS.

In order to make available the facts concerning German foreign trade for the benefit of American business men, C. D. Snow, Assistant Chief of the Bureau, with the assistance of J. J. Kral, of the research section, prepared a detailed report on German foreign-trade organization, with a wealth of supplementary statistical material and extracts from official reports on German methods. Much of the material used had previously been issued in one form or another by the Bureau, but there was need of bringing it together, consolidating and coordinating it, and supplementing it with statistics and comment—a task for which Mr. Snow was especially well qualified by reason of having been in Germany investigating commercial and industrial conditions for the Department prior to and during a portion of the war.

## TIN-PLATE CONSERVATION.

Early in the spring it became known that the canners of the country were unable to arrange for the quantities of cans, or tin plate to make the cans, that they felt would be needed to pack the big crops expected as a result of the President's campaign to increase the food supply. This condition was brought to the attention of the Department by the National Canners' Association, and steps were at once taken to find a remedy. The plan finally agreed upon was to conduct a campaign practically to divert tin plate and cans for a limited period to the packing of perishable foods. This campaign was carried on largely through the Bureau of Foreign and Domestic Commerce.

A study of the situation revealed the fact that the can makers were demanding a third more cans than they had asked for in 1916, a very busy year. At the same time the plate mills were having more trouble than usual in meeting demands owing to the difficulty of getting sheet bars from the steel mills and the lack of sufficient cars to move in raw materials and take the finished product away.

At the request of the Secretary of Commerce, the tin-plate conservation committee was formed, composed of representatives of the tin-plate industry, the can-making industry, the canners, and the wholesale grocers, together with the Chief of the Bureau of Chemistry of the Department of Agriculture and the Chief of the Bureau of Foreign and Domestic Commerce. This committee met frequently during the summer and made recommendations to the Secretary of Agriculture and the Secretary of Commerce. One of these recommendations led to an agreement whereby the tin-plate manufacturers and can makers, with the consent of canners and wholesale grocers, showed a preference for the packers of perishable foods in their shipments. This preference continued until the perishable crops had been packed.

Under the direction of our Mr. C. P. Carter as secretary of the committee, attention was also given to the problem of stimulating the production of tin plate. Some of the mills made arrangements to run an additional turn each week, and provision was finally made to supply most of the needs of most of the mills for sheet bars and transportation. To accomplish this the cooperation of the steel mills and the war board of the American Railway Association was necessary, and the work of the latter played an important part in the successful completion of our task. Exports of tin plate were also limited to some extent. An address in the Senate by Hon. Bert M. Fernald, in which was revealed the tin-plate situation in the country, was largely responsible for the enactment of the clause in the espionage act which provides for governmental control of exports.

Having thus diverted containers from the packers of nonperishable products, the next natural and fair thing to do was to assist these packers in their efforts to develop suitable substitute containers for their products. The facilities of the Bureau of Standards were accordingly focused on testing various paper containers. When sufficient accurate information had been obtained a pamphlet was prepared jointly by both Bureaus and distributed gratis by the Bureau of Foreign and Domestic Commerce. Thousands of copies were disposed of advantageously, and a list of manufacturers of paper and fiber cans was sent to inquirers.

The question of reusing old cans was also considered, but it was decided that the best plan would be to encourage the collection of such cans for detinning, so that the tin and plate could be recovered for further use in manufacture. The expansion of this industry is receiving serious consideration in various parts of the country, and if favorable action is taken an important saving of tin and steel may be expected.

The decrease in our imports of tin from the Straits Settlements and England led to a discussion with the commercial adviser of the British Embassy as to the possibility of making arrangements with the British Government for the release of larger shipments and the diversion of such shipments so far as possible across the Pacific to avoid the dangers of the submarine zone. There was, however, no really acute shortage of pig tin in this country at any time.

#### FOREIGN EMBARGO LEGISLATION.

American exporters have had many perplexing problems to contend with since the war started, and not the least of these has been the difficulty of keeping abreast of the embargo legislation and other trade restrictions of the belligerent and neutral countries. The difficulty lies in the fact that numerous changes are made almost daily and that a great many countries are involved. From the beginning of the war the Bureau has made a specialty of accurate and detailed information on this subject, and during the last year more time than ever before has been devoted to this important feature, under the immediate supervision of Mr. Louis Domeratzky, the tariff expert of the Bureau. It is probably safe to say that the Bureau of Foreign and Domestic Commerce is the only place in this country where practically complete and scientific information on the subject of foreign trade restrictions is made available to the general public.

#### HOW THE BUREAU HELPED TO REDUCE THE CAR SHORTAGE.

As the Bureau is in close touch with the trade organizations of the country, it was able to render assistance to the commission on car service in its efforts to secure a more efficient use of freight-carrying equipment. The matter was taken up with the trade organizations and their cooperation invited. They were urged to inaugurate intensive campaigns in their districts, and it is known that the situation was considerably relieved in this way. Suggestions as to how the car shortage could be reduced were prepared in the Bureau and distributed widely. The Bureau takes some pride in the fact that these suggestions are now being used by the commission.

#### PRIORITY.

Responding to the invitation of the priority committee of the General Munitions Board of the Council of National Defense, the Chief of the Bureau of Foreign and Domestic Commerce was made a member of that committee, and a representative of the Bureau attended the daily meetings of the committee and assisted in determining the policies of that body. Prior to the creation of this committee the Bureau was able to assist many manufacturers of essential commodities in securing priority in the manufacture and delivery of raw materials.

## IMPORTATION OF RUSSIAN RAW MATERIALS.

The agreement entered into on September 23, 1915, between the Secretary of State, on behalf of the United States, and the Russian Ambassador, on behalf of the Russian Government, for the release of Russian raw materials, was still in effect at the end of this fiscal year. This agreement, which was the result of the active efforts of Russian Government officials and representatives of the Bureau of Foreign and Domestic Commerce, has up to date, in spite of many difficulties and restrictions, made possible the direct importation of a large quantity of Russian raw materials to the United States. Nearly \$8,823,765 worth of such materials has actually been released by the special representative of the Secretary of Commerce. Permission has been granted by the Russian Government for the exportation of approximately \$16,000,000 worth of material, and the total applications filed by American firms for almost every variety of merchandise totaled about \$30,000,000. It is quite evident from these figures that there is an immense market in this country for Russian raw materials. In fact, it is estimated by the Bureau that between \$70,000,000 and \$80,000,000 worth of such raw materials could be consumed annually in this market, which in itself forms a sound nucleus for the development of a large reciprocal trade between Russia and the United States after the war. Under present shifting conditions negotiations for a commercial treaty are almost impossible.

As heretofore, it is necessary for American firms wishing to obtain goods from Russia to file an application in triplicate with the special representative of the Secretary of Commerce in the New York office of the Bureau. Once permission has been obtained, it has been necessary to file, for acceptance and approval by the representatives of the Russian Government, an indemnity bond covering the invoice value of the goods.

Effective May 14, 1916, in addition to the above requirements, there was established a new procedure for payment of all goods purchased in Russia and exported to America. If an American importer desires to purchase commodities in Russia for exportation to America he must, in each instance, furnish the Russian commercial attaché in New York City with a guarantee to the effect that the value of the shipment in American dollars has been deposited to the credit of the "Section Etrangère, Ministère Finances" in the National City Bank of New York City, so that the Minister of Finance may pay to the Russian exporter the equivalent of these dollars in rubles, at a rate fixed by the clearing house at Petrograd, the day the dollars were deposited in New York City.

On the applications filed for release of merchandise from Russia it is necessary for the prospective American importer to state definitely (a) the quantity of merchandise, (b) the value of same in American dollars, (c) the name and address of the Russian exporter to whom the license to ship should be given. Also, the Russian commercial attaché should be furnished with a letter from the National City Bank stating the amount deposited by the American importer to the credit of the account of "Section Etrangère, Ministère Finances."

The above restrictions and requirements have worked a hardship on the American importer, and the depreciation in value of the Russian ruble has meant a loss in certain cases of from 25 to 50 per cent

of the money deposited. This specially applies to goods already paid for in Russia subsequent to May 14, 1916. The paying over to the seller of rubles at a rate fixed by the Petrograd clearing house means a loss to the purchaser, inasmuch as there is a difference in value of the ruble between New York and Petrograd. In nearly all cases the buyer here in the United States has been obliged to make up the difference through an increased credit in favor of the seller in Russia. However, an American importer, through his representative in Russia, can always obtain from the correspondent of a Russian bank a certificate covered by a letter of credit in American dollars, which, we have been informed, will be approved and accepted by the Russian Ministry of Finance.

The Russian Government is undoubtedly anxious to allow as large an amount of Russian materials to go to the United States as possible, but it was impossible to grant all the applications made by American firms, as about 38 per cent of the different materials was needed for its own war purposes, and the Russian Government up to this date has refused to allow the exportation, with a very few exceptions, of calfskins, goatskins, sheepskins, flax, and wool.

#### PLANS FOR A FAR EASTERN DIVISION.

Important preliminary steps were taken during the year toward the establishment in the Bureau of Foreign and Domestic Commerce of a far eastern division, or division of oriental affairs, which will specialize on commercial matters in China, Japan, India, and other countries in the Orient in much the same way that our successful Latin American division has specialized on commercial affairs in the Republics to the south of us.

The opportunity came shortly before the beginning of the fiscal year, when it was found necessary to send some one from the United States to take charge of the Peking office during the absence of the commercial attaché on his recent tour of this country. John R. Arnold, who had lived six years in the Philippines and had traveled extensively in most of the far eastern countries, was selected and instructed to combine with the duties of the position certain preparatory and research work in China and Japan which would lead directly to the development in the Bureau a little later of a definite program relating to the Far East.

The feature of the far eastern work which will receive the most attention at first is what may be called a "far eastern file," the most important sources of information for which will be the reports, published and unpublished, of the consuls, commercial attachés, and others reporting for the Bureau; the trade letters written by these officials and now filed in the Bureau; miscellaneous material from publications of all descriptions; and, perhaps most important of all, current periodicals wherever published that are devoted to commercial, industrial, and financial conditions in the Orient.

Another feature of the new division will be educational work in certain matters of trade policy and practice in the Orient. When the time arrives that the proposed division can introduce American capital to the purchase and maintenance of banking or public-service properties in the Orient, the climax of its effectiveness will have been reached. The working out of this program will necessarily be a

matter of time, but it is felt that every step taken in accomplishing it will be a decided gain. There is a high degree of interest everywhere in the idea here outlined, and there can be no reason to doubt that it opens up large possibilities of benefit to American business and finance in one of the greatest purchasing and productive areas of the globe. Congressional appropriation is the only thing needed to set the plans afoot.

#### MEDIATION IN COMMERCIAL DISPUTES.

During the year representatives of the Bureau have rendered what I consider very vital assistance to our commerce by acting as mediators in commercial disputes between foreign importers and American exporters. It often happens that disputes of this kind lead to ill feeling, which affects not only the particular house against which the grievance is held but also American exporters in general. Through the Consular Service and through its own commercial attachés and special agents in the field, and its district and cooperative offices at home, the Bureau is able to get both points of view in most disputes, and find a way to effect a satisfactory adjustment. In this work our representatives have at heart only the best interests of American business, and assume no legal responsibility or attributes.

Mediation and conciliation have some advantage in commercial disputes not possessed by the better-known plan of arbitration. Mechanism for arbitration of commercial disputes should by all means be available. There are occasions, however, when arbitration merely disposes of a dispute without really satisfying either party. Ill feeling sometimes remains after the arbitrator has disposed of the case and washed his hands of the affair.

An example will make the point clear. An important firm in a foreign country became dissatisfied with an American shoe manufacturer in transactions that had been conducted in part by letter and in part by cable. Our commercial attaché investigated the matter from the viewpoint of the importer, and the Bureau, through the Boston district office, took it up with the manufacturer. As a result, the Bureau not only saved the shoe manufacturer a substantial account, but also saved the good will of the foreign house, which imports other lines of American goods.

A less important but very interesting case was that of an importer in one of the British self-governing dominions who complained that some picture frames he had ordered were not finished in the manner specified in the catalogue of the American manufacturer. One of our district office managers pointed out to the manufacturer that the description in his catalogue might be ambiguous to the foreign buyer, and the complaint was adjusted satisfactorily to both parties. The manufacturer, grateful for the Bureau's friendly offices, corrected all his catalogues in order to prevent similar misunderstandings in the future.

A consignment of dolls that arrived in damaged condition was the cause of another dispute successfully settled. The American consul who examined the goods reported that the packing was all that could be desired, and that he was unable to account for the breakage. The manufacturer also was unable to explain the cause

of the trouble, but after negotiations conducted through one of the district offices a completely satisfactory settlement was made.

Among the many cases that have come up there have been a few, of course, where a satisfactory adjustment was hindered by the obvious intention of one party or the other not to act fairly. Such cases are not common, but they sometimes have more far-reaching results than the parties concerned seem to realize. As a rule, the American manufacturer or exporter wants to give satisfaction to his foreign customer, and, if his shipments are in any way unsatisfactory, he is prompt to make good his implied guaranty.

#### PROTECTION OF AMERICAN TRADE-MARKS.

The Bureau's division of foreign tariffs put into successful operation during the year a plan to protect owners of American trade-marks from loss and inconvenience in certain South American countries. In these countries the ownership of a trade-mark is based on priority of registration and not of use, as is the case in the United States, so that a person who registers the mark first has the right to keep the rightful owner from importing into the country goods bearing the registered trade-mark. In many cases American manufacturers have been compelled to buy back their own trade-marks and in some cases have found it cheaper to use a new mark for certain countries. Instances have been found where the agents of American concerns have registered the marks of the firms they represent, so that the agencies can not well be taken away from them.

To put an end to such abuses so far as possible, the division of foreign tariffs has adopted the plan of scrutinizing carefully all applications for trade-mark registration in certain Latin American countries. When it finds an application for the registration of an American trade-mark or a close imitation it promptly notifies the American owner of the mark, explains to him the main features of the trade-mark laws in the country in question, and urges him to protest the registration of his mark by an unauthorized person. He is instructed in the procedure to be followed. The division has been successful in its determination to head off schemes of this kind, and a number of American firms have written to the Bureau expressing their appreciation of the service.

It is not true, of course, that there is any greater disposition in the Latin American countries to impose upon the rightful owners of trade-marks than is to be found elsewhere. In all countries there are to be found individuals who are alert to despoil those who excel in inventiveness, initiative, and industry. The simple truth is that the American manufacturer is more at the mercy of sharpers in foreign countries than he is at home, where he is familiar with the laws and with the tricks and devices of the unscrupulous. The Bureau can render a most legitimate and important service to the manufacturer in this connection.

#### CHANGES IN ASSISTANT CHIEFS OF BUREAU.

During the year Mr. E. A. Brand, Assistant Chief of the Bureau, did a considerable amount of traveling in Europe and South America. Mr. Brand resigned as Assistant Chief and during the



latter part of the year served as a special trade commissioner. During the latter part of the year, also, Dr. Frank R. Rutter was promoted from the position of Assistant Chief to the position of commercial attaché at Tokyo, Japan. C. D. Snow, an employee of the Bureau since 1910, was promoted to the position left vacant by Dr. Rutter. The present Chief of the Bureau, Burwell S. Cutler, of Buffalo, N. Y., was appointed Assistant Chief in place of Mr. Brand.

#### IMPROVEMENT OF PERSONNEL.

By Executive order the positions of trade commissioner, commercial agent, expert, and special agent were transferred to the civil service during the year. This was in line with the policy of improving the personnel of the Bureau and was the next logical step after the action of the previous year, at the direction of the Secretary of Commerce, in requiring applicants for these positions to take a Department examination. The transfer was decided upon only after very careful consideration. Through the cordial cooperation of the Civil Service Commission, the change has worked satisfactorily, even in the stress of numerous emergency appointments after the outbreak of war.

Since the transfer of these positions from Schedule A to Schedule B, under the civil-service rules, 13 special written examinations have been held by the Civil Service Commission, in which 402 candidates participated. Eighty-one of these candidates received passing marks and 19 received appointments. Prior to the transfer, but during the fiscal year 1917, two written examination groups were held by the Bureau and 111 candidates were examined. The total number of persons called to Washington for oral examination was 60.

It is a pleasure to report the satisfactory results achieved by the appointments committee of the Bureau. This committee is made up of members of the Bureau staff who make recommendations to the Chief of the Bureau in regard to all appointment matters. The committee hears grievances of employees, passes on the merits of all members of the staff, and in a broad way relieves the Chief of much of the responsibility of passing judgment on matters of personnel, concerning which, owing to the pressure of other business, he is not always able to keep himself posted in detail.

The work of the committee includes (1) suggesting examination qualifications, (2) fixing examination dates, (3) proposing the examination questions, and (4) advertising examinations and consultations with persons most likely to know of suitable candidates. Its duties were heavy during the last year, especially during the final months when the committee was called upon to assist in locating in advance a large force to undertake the licensing of exports.

#### INDICATIONS OF EFFECTIVE WORK.

The effectiveness of the trade-promotion work of the Bureau can only in part be estimated by the importance of the concrete advertised results obtained. The Bureau does, of course, render numerous services of great value to the American manufacturer and exporter in addition to putting him in touch with opportunities that result in actual sales.

During the year there accumulated at the headquarters of the Bureau a large number of unsolicited expressions of appreciation of the practical end of the Bureau's activities. It would serve no purpose to devote space to printing a great number of these, but a few typical examples will make it plain that the Bureau has not neglected the practical side of foreign-trade promotion work.

As usual, steady returns in actual sales have resulted from the "Trade opportunity" page of the daily Commerce Reports. Reports from consuls and Department of Commerce representatives have shown a total of new business running well into millions of dollars each year. The following enumeration of direct results obtained from this page by a New York exporter indicates the possibilities of this service:

An electrical house in Manchester, England, has placed with us orders amounting to \$25,000.

A good connection has been made with a concern in Glasgow for heavy hardware.

Automobile tires have been sold in India, Philippine Islands, Malay Peninsula, Siam, and Sumatra.

Orders for hosiery received from Copenhagen, Lisbon, Vladivostok, Johannesburg, and Auckland.

Other lines sold in British Guiana, British Honduras, Porto Rico, and other territories in the West Indies.

Concerning this same "Opportunity" service a Chicago firm has volunteered the following information:

As a result of an opportunity published sometime ago we have received a contract to supply a Chilean house a large order and to furnish them military ornaments and other articles of our manufacture.

Through our district offices it is possible to call direct attention to trade opportunities with the least possible delay. The effectiveness of this method is indicated in the following communication from a Chicago house:

You will recall that about one month ago you called me over the telephone and asked me if I was interested in giving a quotation on 60 typewriters, Spanish keyboard, to a firm in Peru. I am pleased to report that I have been able to secure the order in question which amounts to a little over \$3,000. I will say once more that we have found that several of our best customers have been secured by the names furnished us by the Bureau of Foreign and Domestic Commerce.

Through the Consular Service, our traveling special agents, and our commercial attachés, the Bureau finds it possible to put American concerns in connection with firms and individuals in foreign countries who desire to represent American concerns in their districts. The Bureau assumes no responsibility in recommending such firms and individuals but has been instrumental in arranging many valuable connections in this way with a minimum of dissatisfaction to either party. The following commendation of this service has been received from an exporter on the Pacific coast:

As export manager of my firm it has been part of my work to keep in close touch with the consuls in the various cities throughout the world with the object of securing reliable firms to act as our representatives, and though the consuls accept no responsibility in referring these people to us, it affords us great pleasure to state that each of our representatives has proven to be a most reliable and energetic business man.

A somewhat similar service is rendered by the Bureau in assisting foreign buyers who visit this country to make connections with American manufacturers. The following letter from an Australian buyer who recently visited this country shows the practical value of this particular service:

Owing to the assistance rendered to me by your Department I have been successful in securing the agency for Australasia for one of the largest shoe manufacturers in the United States; also a large cotton mill and manufacturer of clothing. I feel confident that without your assistance I should not have been so successful.

Another feature, already referred to, that often has definite results is that of having returned consuls, special agents, and commercial attachés tour the country for the purpose of addressing and interviewing the business men interested in foreign trade. These officials are introduced to the business communities through our district offices, and the beneficial results of the visits are sometimes easy to trace. The commercial agent in charge of the New York office cites the following interesting example:

The sales manager of a piano company has recently been able to close a deal appointing an agent in Copenhagen for the general representation of his company which included a preliminary order for 100 pianos to be shipped immediately to Copenhagen. This resulted directly from Consul General Winslow's recent visit to our office.

In the far-off Dutch East Indies a firm of exporters tried long and hard to place large contracts in this country for desks. They finally succeeded with our cooperation and have expressed their appreciation as follows:

We feel obliged to express our sincere thanks to the Bureau of Foreign and Domestic Commerce for the aid given us in our search for the right manufacturer, and especially to the Chicago office of the Bureau, which has assisted us a great deal in obtaining what we wanted. We appreciate the good work of the Bureau very much.

Although the primary object of sending abroad our special agents is to make a survey of commercial conditions in certain lines in prescribed districts for the purpose of furnishing preliminary fundamental information to concerns interested in foreign trade, these special agents are at times in an excellent position to promote sales of goods by calling attention of American manufacturers to specific openings. One of the most successful of our agents in this respect has been Ralph M. Odell who, during his connection with the Bureau has studied the markets for American textiles in practically every corner of the globe. His last investigation included the Far East and British India and, on reports from manufacturers and exporters, it has been estimated that there resulted, in good part from his efforts, sales of American merchandise totaling something like \$3,500,000. It should be borne in mind that these sales resulted from the special agent's activities while on the ground. The benefits derived by American business from his formal reports can never be estimated, although it is not unlikely that they will prove more valuable to the American textile industry in the long run than his sales-promoting service rendered while at work.

Our older special agents are convinced from their own experience that our preliminary services have achieved an importance that formerly they did not enjoy. Some of these agents recall visits to well-

known concerns a few years ago when they not only found it necessary to explain in detail what the Bureau was, what it was driving at, and what the duties of special agents were, but were amazed at the lack of even rudimentary information concerning foreign markets and the opportunities and methods of reaching them. Now they frequently find their own reports on the desks of officers of such concerns when they call. There is no longer the need of preliminary explanations; they find themselves on a business footing from the outset. Our agents now meet the representatives of private concerns on foreign soil with copies of special agents' reports and other Bureau of Foreign and Domestic Commerce publications in their bags.

As for the Bureau's influence in shaping the policies that underlie the foreign trade of the country, it is now possible to point to a number of instances in which decidedly desirable results have been achieved. It is possible, for instance, to estimate the effect of the Bureau's long campaign for better packing in our export trade. Our own representatives as well as the representatives of private business concerns seem agreed that complaints on the score of poor American packing are far less frequent. The foreign exporter may still find fault at times, but, as a rule, he is willing to admit that we are learning our lesson. To Special Agent Halsey a prominent South American exporter expressed the following comforting opinion:

Many American houses now pack their goods as well as anybody. The American is sometimes hard to convince, but once convinced there is no one in the world more adaptable.

The Bureau, of course, does not claim all the credit for this result, but it does feel justified in assuming that its long campaign has had worth-while results.

#### COMMERCIAL AGENTS.

The first day of the fiscal year 1917 marked the creation of a separate division in the Bureau to take charge of the field investigations—the division of commercial agents. This change was the result of the increased attention being paid by the Bureau to this branch of its work, and of the number of new investigations made possible by increased appropriations. On July 1, 1916, there were 13 investigators; on January 1, 1917, this number had been increased to 18; and on June 30, 1917, there were 26 field investigators. The assigning of one man to take charge and give his entire attention to the direction of special investigations, is in line with the recommendation made by the special committee of the Chamber of Commerce of the United States chosen to consider all phases of the Bureau's activities.

The functions of the division of commercial agents relate to the following subjects: The selection of new investigators, assistance in securing the names of suitable and available applicants for the various examinations, the determination of the scope of the investigations and the length of time they should take, the direction of the men chosen, the critical reading of all their reports and correspondence (except that relating to accounts), the advancement of all worthy projects suggested or personally initiated on the ground by the field agents, and the coordination of this branch of the Bureau's activities with private business. In short, the division assists the chief and assistant chiefs of the Bureau with regard to all the administrative

details of field investigations conducted by trade commissioners, commercial agents, or special agents. The personnel of the division consists of a chief, assistant chief, editor, and stenographic assistant.

#### IMPORTANCE OF INVESTIGATIONS.

Our trade-promotion service has been particularly effective by reason of the stress laid on the employment of specially trained men in securing first-hand knowledge abroad. Other leading nations have made extensive use of resident agents, such as consuls and attachés, and also temporary commissions composed of men of social position, but no other country has equally developed a changing staff of experts in particular industrial lines for current foreign reports.

It is not an easy matter to decide how our budget for field investigations can be employed to the greatest advantage of American business and financial interests. The funds available are drawn from two allotments, one of which must be directed toward studies in Latin America, the other embracing all the rest of the world, including the United States. In the past, a large proportion of the Government funds available has been spent on straight trade investigations of present and potential markets for individual lines of American manufacturers. During the fiscal year under review more attention was given to broad investigations designed to benefit as many industries as possible and yet be sufficiently specific to warrant the time and money spent. The first study of new or comparatively unknown markets requires information on the geographical and commercial conditions peculiar to the territory, and likewise the nature of the inhabitants, with special consideration of different races and nationalities, purchasing power, and local habits and customs. Good general reports on credits, merchandising, laws and customs, resources, and industries have their place as the forerunners of more specialized reports.

Many of our recent investigations resulted from requests from leading business associations. It is to be hoped that American business interests will take an increasingly keen interest in our investigations and submit any suggestions that occur to them. Inasmuch as it is necessary for us to look ahead at least two years in mapping out our new investigations it is no easy matter, particularly in these unsettled times, to fix plans for the future.

The increasing interest taken by American firms in the Bureau investigations is indicated by the following letter written to the Bureau by the president of one of the largest furniture companies in Michigan:

Our industry now, however, has reached a stage where we should have reliable, first-hand information, and we can not help but feel that Mr. Everley's trip will be highly constructive so far as we are concerned, in view of the experience he has had in South American countries. Judging from our own experience we have been exploited by various publications, would-be commercial agents, etc., to a considerable extent, who have proposed to develop South American business for us through advertisements, direct representation, etc. However, on investigation these schemes have too frequently proven to be purely efforts to sell advertising space, printed matter, or pay the expense of some individual to go down into those countries to get experience. We have therefore come to look upon these schemes in general with considerable skepticism. This move, therefore, on the part of the Department of Commerce,

should set us right and be of very great value to those manufacturers who are or can produce merchandise suitable for South American trade, and so far as we are concerned we are anxious to give you our hearty support so far as we are able in the carrying out of this investigation.

#### PERSONNEL OF THE FIELD STAFF.

The utmost care is given to selection of men to undertake the work. Every applicant must answer satisfactorily a set of practical questions prepared generally by a leading authority in the particular subject; he must demonstrate his ability to write clearly and concisely; he must be familiar with foreign languages in most instances, such as having a working knowledge of Spanish if he is to be sent to South America; and his general education and experience for the particular investigation is given a relatively high weight in determining his qualifications. Applicants who pass well in the written examination must also successfully pass the oral examination before they are in line for appointment. Prominent business men are invited to sit with the Government examiners in passing on candidates in the oral examinations, where personal fitness as well as practical training are rated.\* The selections of trade commissioners, commercial agents, and special agents, as a result of these examinations, held under the United States Civil Service regulations, with as much advice from competent business men as possible, has produced an unusually able force of men possessing high-grade business ability and strong personal character.

#### PREPARATORY WORK IN THE UNITED STATES.

Too much emphasis can not be given to the importance of careful preliminary preparation in connection with all Bureau investigations. Government work is new to practically all appointees, and it is necessary for them to get the promotive spirit of this Bureau, with a clear understanding of what American manufacturers and exporters expect of them.

One of the first acts of the Bureau after the agent reports is to communicate with executives of important trade bodies and commercial associations that should be directly interested in the investigation. We enlist the cooperation particularly of trade associations, which generally furnish us on request a list of their members that can be circularized, either by the Bureau or through the association direct, and in addition the executive officer of the association furnishes letters of introduction for the investigator to the officials of leading business houses. The scope of the investigation is made more definite as a result of conferences with business men. Then follows a public announcement of the investigation. Interested firms are circularized. Several investigators started in March, when 2,500 letters were sent from the office, and it is interesting to note that approximately 40 per cent of these letters were answered. In connection with our investigation of the South American markets for jewelry and silverware over 200 letters were sent out, from which we had a 25 per cent response within one week after these letters were

\* The examination system described is in its main outlines similar for all responsible positions in the Bureau's field and Washington staff.

dispatched. The purpose of sending out these letters is chiefly to determine the degree of interest of the individual firms in the investigation. With these replies as a basis, the agent's preliminary trip in the United States, lasting, according to the investigation, from six weeks to three months, is planned.

One to two weeks is generally spent in New York at the very start of the investigation; a similar stay is made in Washington, conferring with the chiefs of the various divisions of the Bureau and also with other Government departments, and the balance of the time is spent in travel through the United States. In the case of the Bureau's more general investigations relatively more time is spent in New York and Washington. On the agent's trip through the United States he makes his headquarters at the district and cooperative offices of the Bureau, and in other places with the board of trade or chamber of commerce or the local office of one of the trade associations. This preliminary trip through the United States gives the agent the advantage of conferring with individuals and firms that have had varying experiences in foreign trade.

#### COOPERATION WITH OTHER GOVERNMENT DEPARTMENTS AND PRIVATE BUSINESS.

The efforts of the Bureau during the present fiscal year have been greatly assisted by the hearty cooperation of various Government bureaus, leading trade associations and commercial bodies, the trade and general press, and private firms and individuals. In every investigation our purpose has been to lay out as definite a piece of work as possible and then solicit the aid of all public and private agencies in bringing our activities to a successful completion.

It is impossible to state in any complete way the specific assistance accorded us by the executive departments of the Government. The Department of State, through its diplomatic and consular officers, has greatly helped in foreign countries. The United States Geological Survey prepared and corrected certain technical examination papers. The Bureau of Mines has secured interesting and valuable material for our agents investigating natural resources. The Bureau of Standards has extended the use of its staff and laboratory facilities for articles of foreign manufacture sent us by our field investigators. The Office of Markets and Rural Organization, of the Department of Agriculture, assisted materially in the investigation of South American markets for fruit, and the Forest Service, of the same department, helped materially with the lumber investigations. This coordination of our work with other Government bureaus has given our investigations a standing and produced results that would not otherwise be possible.

Leading associations in export work, notably the National Association of Manufacturers, the American Manufacturers' Export Association, the National Foreign Trade Council, the Philadelphia Commercial Museum, and the Pan American Union, extended to the Bureau their hearty cooperation. Unusually satisfactory relations have been maintained with trade associations continuously from the inception of the investigations. Among the associations that deserve special mention are the following: National Lumber Manufacturers' Association, National Implement and Vehicle Association, National Jewelers' Board of Trade, American Pulp and Paper Association,

Federation of Furniture Manufacturers, National Association of Steel Furniture Manufacturers, National Association of Boot and Leather Manufacturers, New England Shoe and Leather Association, American Cotton Manufacturers' Association, National Cotton Manufacturers' Association, National Wholesale Grocers' Association, National Automobile Chamber of Commerce, American Association of Port Authorities, American Hardware Manufacturers' Association, and the Association of National Advertisers. The Chamber of Commerce of the United States and its various members throughout the United States have also aided the Bureau greatly. The trade and general press have given excellent publicity to our investigations, and moreover the editors of several trade papers have given much time during the present fiscal year in suggesting new investigations, in assisting in the preparation of examination questions, and in the grading of examinations in accordance with the requirements of the United States Civil Service Commission. A leading electrical journal has furnished Special Agent Lundquist with the list of their subscribers in the Far East, which may be used in several cases as an opening wedge for procuring valuable information.

## RECORD OF FIELD INVESTIGATIONS.

The following tables present a complete record of specific trade investigations and general economic investigations conducted by past and present field agents of the Bureau. The subject of the investigation, the name of the agent, the territory studied, and the fiscal year or years of the investigation are stated herewith.

## INVESTIGATIONS OF FOREIGN MARKETS FOR AMERICAN PRODUCTS MADE BY SPECIAL AGENTS OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

## SPECIFIC TRADE INVESTIGATIONS.

Subject of investigation.	Agent.	Europe.	Near East.	Far East.	Africa.	Latin-America.	Australasia.	Canada.	United States.
Agricultural implements.	Dennis..... von Moltz..... Horns.....	1908	1908	1909	.....	1916-17	.....	.....	.....
Alcohol, denatured.....	Crampton.....	c 1914	.....	.....	1916-17	.....	1917-18	.....	.....
Boots and shoes.....	Butman b..... Brock..... Bosworth b..... Shriver.....	1907-13	1912	.....	1913	1908-10 1916-17	1917	.....	.....
Canned goods.....	Norton.....	c 1914	.....	1917-18 1913	1918-19	.....	.....	.....	.....
Chemicals and dyestuffs.....	Jones, G. M.....	d 1911	.....	.....	.....	1917-18	.....	.....	1915-17
Coal.....	Ewing.....	.....	.....	.....	.....	1917-18	.....	.....	.....
Construction materials and machinery.	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cotton goods.....	Crist..... Burrill..... Whittam..... Clark..... Hauser..... Odell..... Brooks.....	.....	.....	1905 1905	.....	.....	.....	.....	.....
Electrical instruments and meters.	.....	c 1907	.....	.....	.....	.....	.....	.....	.....
Electrical goods.....	.....	1908	1908	1906	.....	1910-11	.....	1913	.....
Flour.....	.....	c 1912	.....	.....	.....	.....	.....	.....	.....
Fruit.....	.....	1912	1912	1915-18	1913	.....	.....	.....	.....
Furniture.....	.....	1912	.....	.....	.....	.....	.....	.....	.....
	Smith.....	.....	.....	1917-18	1918-19	1916-18	1917	.....	.....
	Lundquist.....	.....	.....	.....	.....	.....	.....	.....	.....
	Davis.....	1908	1909	.....	.....	.....	.....	.....	.....
	Turner.....	.....	.....	.....	.....	1911	.....	.....	.....
	Fischer.....	.....	.....	.....	.....	1916-17	.....	.....	.....
	Everley.....	.....	.....	.....	.....	1917-18	.....	.....	.....

c Compilation.

b Also all kinds of leather goods.

d Southern Europe.

e American consul at Chemnitz, Germany, on detail to Department of Commerce as commercial agent.

f England only.

g India.



## INVESTIGATIONS OF FOREIGN MARKETS FOR AMERICAN PRODUCTS MADE BY SPECIAL AGENTS OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE—Continued.

## SPECIFIC TRADE INVESTIGATIONS—Continued.

Subject of investigation.	Agent.	Europe.	Near East.	Far East.	Africa.	Latin-America.	Australasia.	Canada.	United States.
Hardware.....	Brill.....					1915			
Iron and steel.....	Williams.....		1918-19	1917-18	1917				
Jewelry and silverware.....	Pepper.....	1909							
Linen, jute, and hemp.....	Rosenthal.....					1917-18			
Lumber.....	Clark.....	1914							
	Simmons.....	1917-19				1915-17			
	Smith.....			1915-16					1915
	Benson.....								
	Brown.....	1917-19							
	Walker.....	1917-19							
	Oxholm.....	1917-19							
Machinery and machine tools.....	Carden.....	1909-10							
	Alexander.....			1911-13			1913		
	Massel.....					1915-17			
	Grimshaw.....					1917			
Medicines, proprietary.....	Thayer.....					1913			
Motor vehicles.....	Jones, T. O.....	1919		1917-18					
Oilseed products.....	Broda.....	1910	1910						
	Thompson.....	1914							
Pottery.....	Pepper.....	1906							
Paper, paper products, and printing supplies.....	Barrett.....					1917-18			
Railway materials, equipment, and supplies.....	Rhea.....			1917-18	1918-19		1917		
Surgical instruments and supplies.....	Thayer.....					1913			
Textiles.....	Tucker.....					1916-18			
Wearing apparel.....	Sams.....			1916-17			1917-18		
	Tucker.....					1918			
Woolen goods.....	Clark.....	1906							

## GENERAL ECONOMIC INVESTIGATIONS.

Banking and credits.....	Wolfe.....	1912							
	Hurley.....					1914			
	Lough.....					1915			
Commercial laws.....	Wolfe.....	1913							
	Borchard.....					1916			
Commercial organizations.....	Wolfe.....	1913							
	Brand.....								1912
General commercial information.....	Doonan.....								1913
	Harris.....					1916-17			
	Brand.....					1917-18			
	Brook.....					1917			
	Smith.....					1917			
	Tucker.....					1917			
Investment opportunities.....	Halsey.....					1917-18			
Marketing methods (export).....	Ferrin.....	1919		1917-18			1918		
	Cherrington.....								1917-18
Mineral resources.....	Clements.....			1917-19					
Navigation laws and merchant shipping.....	Jones, G. M.....	1917							1915
Packing (export).....	do.....					1917-18			1917
Ports and transportation facilities.....	do.....					1917-18			1917
Tariff systems.....	Whitham.....	1919		1917-18			1918		
Transportation rates.....	Rutter.....					1912			
	Sheridan.....					1912			

\* An exhaustive study of the markets for American hardware was made by the commercial attachés in their respective districts.

1 United Kingdom.

2 Russia.

3 Southern Europe.

4 United Kingdom, Belgium, Holland, and France.

5 Scandinavian countries.

6 Chile; also working in conjunction with commercial attachés in other Latin American countries.

7 East and Middle West.

8 South and Pacific coast.

9 Danish West Indies.

10 Work done in the United States.

11 Russia.

12 Including preliminary work in United Kingdom and France.

## TRADE INVESTIGATIONS.

## AGRICULTURAL IMPLEMENTS AND MACHINERY.

As a result of the interest of manufacturers of agricultural machinery and implements, expressed through the National Implement and Vehicle Association, the Bureau started two investigations in the fiscal year 1915 dealing with this industry. The territories selected were South Africa and Australia, and South America.

At the beginning of the fiscal year 1917 Commercial Agent Juan Homs was continuing his South African investigation and was stationed at Pretoria, Transvaal. American farm machinery, he found, was well adapted for South African farming conditions. South Africa has no implement factories, and its entire requirements of about \$5,000,000 per annum are imported. Considerable agricultural development is expected within the next few years. This is a logical market for American manufacturers. The South African negro labor, moreover, can use machinery. From South Africa Mr. Homs went to Australia and New Zealand. These two countries have numerous agricultural machinery factories with an aggregate output estimated at \$7,000,000 and \$1,200,000, respectively. American machinery is well known.

The South American investigation conducted by Special Agent Frank H. von Motz was completed satisfactorily during the fiscal year. Mr. von Motz spent the greater part of his time in Brazil and the River Plate countries and found conditions in these countries auspicious for further sales of American agricultural machinery. He reported that the unsettled conditions in South America, together with high freight rates and particularly the scarcity of ships, have resulted in reducing foreign purchases but offer good opportunity for future sales after conditions become normal. His three monographs were published during the year, namely, *Markets for Agricultural Implements and Machinery in Argentina*, Special Agents Series No. 125, 86 pages; *Markets for Agricultural Implements and Machinery in Brazil*, Special Agents Series No. 140, 59 pages; and *Markets for Agricultural Implements and Machinery in Chile and Peru*, Special Agents Series No. 142, 48 pages. A special meeting of the foreign sales managers committee of the National Implement and Vehicle Association was held in Chicago on March 22 to receive from Mr. von Motz the latest information regarding South American conditions.

## CHEMICALS AND DYESTUFFS.

The important work by Dr. Thomas H. Norton was continued during the year, and for three months he was located in the New York customhouse. During the late summer and fall months of 1916 his work was largely occupied with the completion and details of the publication of Special Agents Series No. 121, entitled "Artificial Dyestuffs Used in the United States." This publication had an important influence in building up the new American coal-tar color industry, as it furnished absolutely essential data for the systematic development of the new industry.

## COAL.

Economists are agreed that England's success in merchant shipping may be attributed in part to the fact that Welsh coal has always been available for return cargoes. The United States, with its large importation of raw materials from Latin American countries, is in virtually the same position as Great Britain, and in view of our numerous coal resources, the Bureau decided to make a special study dealing with the markets of Latin America for this product. Grosvenor M. Jones, of Cleveland, Ohio, was selected to undertake this work and in connection with it make a study of an allied subject, namely, ports and transportation facilities. He is also paying especial attention to fundamental problems underlying packing and general freight handling.

In this investigation of the South American coal markets the Bureau had the hearty cooperation of the Bureau of Mines, which has already paid considerable attention to the subject and has published a monograph entitled "United States Coal Available for Export Trade," appearing in English, Italian, Portuguese, and Spanish. Arrangements were made with the Bureau of Mines whereby Mr. Jones was furnished with as many copies of this report in different languages as he wished. Mr. Jones was in Cuba a month; he spent three weeks in Panama; and the balance of the year he was in Lima, Arequipa, La Paz, and Antofagasta.

## COTTON GOODS.

Ralph M. Odell continued his investigations during 1917, spending 10 months in British India. The balance of the fiscal year was spent conferring with members of the American Cotton Manufacturers' Association, the National Cotton Manufacturers' Association, and private individuals interested in his work. During the year five of his monographs appeared, namely, Cotton Goods in Dutch East Indies, Special Agents Series No. 120, 55 pages; Cotton Goods in Ceylon, Special Agents Series No. 123, 39 pages; Cotton Goods in British India, Part I, Madras Presidency, Special Agents Series No. 124, 50 pages; Cotton Goods in British India, Part II, Bengal Presidency, Special Agents Series No. 127, 88 pages; and Cotton Goods in British India, Part III, Burma, Special Agents Series No. 138, 52 pages. Part IV of his India report, dealing with the Bombay Presidency, is in manuscript, and a short general report summarizing the Indian cotton-goods markets is to be written. Mr. Odell was remarkably successful in paving the way for foreign connections for American firms and in presenting just the information desired for important but comparatively new markets. Large sales of American goods can be directly traced to his pioneer work.

## CONSTRUCTION MATERIALS AND MACHINERY.

W. W. Ewing, an engineer of standing, is reporting on markets of South America for construction materials and machinery. The subjects being covered are construction materials with especial attention to cementing materials, clay products, steel products, cast and ornamental iron, roofing materials, glass, floor, and wall finishing

materials, paints, asphalt, wrought iron, steel and cast-iron pipe, valves, fittings and specials, plumbing fixtures, and heating installations. With reference to construction machinery and equipment, the investigation includes power shovels, compressors, drills, derricks and hoisting apparatus, cableways, pumps, pile-driving machinery, mechanical mixers, floating equipment, road-making machinery, and construction tools. Some idea of the field that this investigation covers is indicated by our cooperation in a more or less marked degree with 38 trade associations and scientific societies. Mr. Ewing's itinerary for 1917 covered Cuba, Panama, Venezuela, and Colombia. Two of his monographs have already appeared, *Markets for Construction Materials and Machinery in Cuba*, Special Agents Series No. 139, 61 pages, and *Markets for Construction Materials and Machinery in Venezuela*, Special Agents Series No. 144, 57 pages.

#### ELECTRICAL GOODS.

Two investigations in the field of electrical equipment, machinery, and supplies were conducted during the year. The men appointed for this work were P. S. Smith, formerly in the export department of one of the largest electrical companies, whose investigation of Latin American markets started in the previous fiscal year, and R. A. Lundquist, well known as an engineer and writer on power transmission and other technical subjects, who reported in August, 1916, for Far Eastern work.

Special Agent Smith entered the Bureau's employ in May, 1916, and after making his preliminary trip, he sailed in company with Special Agents Brock and Tucker for Cuba, where he was at work at the beginning of the fiscal year. Progress in this investigation, which involves a study of potential water power, was necessarily slow, but Mr. Smith was able to cover the situation in Cuba, Porto Rico, and the west coast countries of South America (except for a little extra time needed in Chile) during 1917. Two monographs have appeared, *Electrical Goods in Cuba*, Special Agents Series No. 128, 40 pages; and *Electrical Goods in Porto Rico*, Special Agents Series No. 134, 16 pages.

The far eastern investigation conducted by R. A. Lundquist covers power-generating equipment, transmission and distribution materials and equipment, motors and control equipment, electric railway equipment and electric locomotives, combined power plants, meters, lamps, batteries and battery plants, telephone and telegraph equipment, wiring supplies and electric fixtures, electric ranges and other heating appliances, medical and dental apparatus, and various miscellaneous apparatus. Mr. Lundquist spent most of the year in New Zealand, Australia, and Japan. According to his tentative itinerary, he will also cover China, and possibly certain other Far Eastern territory.

#### FRUITS.

Our nearness to South America suggested the value of more concrete information regarding those markets for American fruit. An investigation along this line was started during the fiscal year 1916 under the direction of Special Agent Walter Fischer, formerly of the Department of Agriculture, who studied the native fruit industry

in Brazil, Argentina, Uruguay, Paraguay, Peru, and Chile, and analyzed the conditions there underlying foreign trade in fresh fruit. Mr. Fischer returned to the United States in June, 1916, and finished his monograph, which appeared as Special Agents Series No. 181, *South American Markets for Fresh Fruits*, 163 pages. He has also prepared a brief report dealing with the dried-fruit situation in South America.

#### FURNITURE.

As a result of former Special Agent Roger E. Simmons's study of lumber markets in South America and after consultation with leading trade associations in the furniture trade, the Bureau discovered that there was considerable interest on the part of the American manufacturers in the possibilities of South America as a furniture market. Accordingly, Harold E. Everley, who was for three years superintendent of the furniture factory of the Brazilian Government at Porto Alegre, Brazil, was selected to make an investigation. It will cover the most important kinds of house, office, school, public-building, and certain kinds of specialty furniture. Cooperation was manifested at once on the part of the trade associations, and Special Agent Everley was successful in arranging the itinerary of his preliminary trip so as to meet as many members as possible of the Federation of Furniture Manufacturers, National Association of Steel Furniture Manufacturers, and the National Home Furniture Association.

Two important local associations are preparing pamphlets dealing with the American furniture industry, printed in Spanish and Portuguese, to be distributed in South America in connection with this investigation.

#### HARDWARE.

The Bureau reports on the hardware markets of various countries prepared by the commercial attachés met with such a hearty response that the Bureau decided to continue this work and appoint a field investigator to make a first-hand study of the markets that are comparatively unknown at the present time in South Africa, India, and the Near East. Charles S. Williams, for years a hardware salesman, was chosen to make this investigation. He reported for duty in March and was immediately greatly assisted in the preparation of his work through the cooperation of the American Hardware Manufacturers' Association. The hardware trade comprises so many different lines that it was necessary to limit clearly the scope of the investigation. As tentatively planned, the investigation now covers in a general way builders' hardware, plumbers' hardware, scales, shelf hardware, saws, files, wrenches, chains, nuts and bolts, and screws. On his preliminary trip Mr. Williams visited the hardware centers of the United States and had the advantage of the discussion at an annual meeting of the American Hardware Manufacturers' Association held in Houston, Tex.

#### JEWELRY AND SILVERWARE.

There has been for some time marked interest on the part of trade associations and leading firms in the jewelry trade in the possibilities of Latin American markets, and this finally resulted in the appoint-

ment of Samuel W. Rosenthal as special agent to make a study of the subject. Mention must be made here of the welcome cooperation of the National Jewelers' Board of Trade, which has contributed both money and time in order to get this investigation under way. The various committees of the National Jewelers' Board of Trade held separate conferences with Special Agent Rosenthal and furnished him with valuable information. On his preliminary trip, upon which he was engaged at the close of the fiscal year, other trade organizations assisted him greatly.

#### LUMBER.

During the fiscal year Special Agent Roger E. Simmons, formerly of the Forest Service, who had completed his South American lumber investigation during the last fiscal year, was on leave the larger part of the second half of the calendar year until his resignation from the service on December 18, 1916. Mr. Simmons made a trip to the far West in the early fall, conferring with manufacturers at San Francisco, Spokane, Seattle, and Portland, Oreg. He was also able to assist firms located in the Middle West. The results of the South American investigation became even more evident during the present year. Partly due to his missionary work in South America, the first shipment of redwood staves for wood pipe was made from the United States early in 1917. Recommendations made by Mr. Simmons in his two monographs, namely, *Lumber Markets of the East Coast of South America*, Special Agents Series No. 112, 121 pages, and *Lumber Markets of the West and North Coasts of South America*, Special Agents Series No. 117, 149 pages, have received the careful consideration of our lumber interests, and there has been a distinct improvement in our lumber exports to the east coast of South America. The Bureau, through Special Agent Simmons, was of great assistance in the formation of the Douglas Fir Export & Exploitation Co. Mr. Simmons has been the secretary of the Northern Hemlock and Hardwood Manufacturers' Association at Oshkosh, Wis. As the result of the examination to select the four European lumber trade commissioners, he was chosen for the Russian investigation, and after resigning from his position in association work, he resumed his Government work on April 30, 1917.

#### LUMBER-TRADE COMMISSION.

A novel form of cooperation on a large scale between the Government and one of the most important industries in the country has been started. During recent years the lumber industry of the country has been in an unsatisfactory condition. Prices have been unstable and the domestic market has been generally demoralized. At the suggestion of prominent lumbermen, the Forest Service, Federal Trade Commission, and the Bureau of Foreign and Domestic Commerce made a study of their problems and reached the unanimous conclusion that the increased cultivation of foreign markets for lumber would prove of immense aid in the solution of their problems at home. Accordingly, these three Government agencies held a meeting in Chicago on August 21, 1916, at which representatives of the leading lumber associations were present. As a result the lumbermen decided that an investigation of European lumber markets,

particularly with reference to conditions after the war, would be of distinct value. The importance of this investigation is evident from the fact that European countries imported annually approximately \$500,000,000 worth of wood and wood products before the war.

Over 300 men took the examinations for the four positions and the following were selected: John R. Walker, whose territory will be the United Kingdom, France, Netherlands, and Switzerland; Nelson C. Brown, who will cover Spain, Portugal, Italy, Greece, and northern Africa; A. H. Oxholm, who will confine his investigation to the study of the resources of Scandinavian countries and Finland; and Roger E. Simmons, who will devote his attention to the timber resources of Siberia and Russia in Europe and their potential lumber production in the next few years following the close of the war. It is interesting to note that several of the leading lumber manufacturers of the United States participated in the examination as sworn examiners.

The members of the lumber-trade commission commenced their term of service in April, and after conferences with the various Bureau officials and lumbermen interested in this investigation, particularly with the National Association of Lumber Manufacturers and the lumber committee of the Council of National Defense, the commissioners started on a two months' trip through the country conferring with the manufacturers and trade associations at the important centers of industry.

The lumber commissioners will leave the United States early in the fiscal year 1918, and it is probable that they will be abroad from 12 to 15 months. Upon their return to this country they will spend 6 months assisting manufacturers in solving their export problems.

They will render to the Bureau full reports, which will be bulletined to the various trade associations that have contributed so heartily toward the success of this mission and without whose co-operation this commission could not have existed.

#### MACHINERY AND MACHINE TOOLS.

Special Agent J. A. Massel arrived in the United States from South America shortly before the end of the fiscal year 1916. He prepared the reports on the markets for machinery and machine tools in Colombia and Venezuela. These reports disclose the fact that these countries are interesting at the present time but offer a comparatively small field for American manufacturers. His reports are available at the Bureau in manuscript form. Mr. Massel is the writer of two publications of the Bureau, namely, *Markets for Machinery and Machine Tools in Argentina*, Special Agents Series No. 116, 64 pages, and *Markets for Machinery and Machine Tools in Peru, Bolivia, and Chile*, Special Agents Series No. 118, 88 pages. It was intended that Special Agent Massel should study also the Brazilian markets before returning to this country, but he was prevented by serious illness, from which he is now fully recovered. Mr. Massel's assignment with the Bureau terminated on October 6, when he left the service. The Brazilian investigation, however, was reconsidered in the latter part of the fiscal year, and Dr. Robert Grimshaw, of New York, a man of considerable business and engineering experience and who had spent 20 years abroad, was selected to under-

take this work. Dr. Grimshaw was in the Bureau service from April 2, 1917, to June 15, 1917, and during this time conferred with manufacturers and merchants on this investigation. However, because of general conditions partly caused by the war, the Bureau decided to postpone indefinitely this study of Brazil's metal-working machinery possibilities.

#### MOTOR VEHICLES.

The automobile industry, which has built up such a striking domestic business in a few years' time, is now figuring prominently in the export field. Especially since the outbreak of the war foreign orders in large volume have been streaming in to practically all the companies of standing. The American lower-priced cars particularly have a promising future in most foreign markets. The prospects in the Far Eastern territory and Russia seemed to the Bureau particularly good, and Tom O. Jones was chosen to make an investigation. He will make a study of pleasure cars, industrial vehicles, and accessories. He will consider the possibilities for gasoline, steam, and electric vehicles and will visit the Far Eastern territory, including Japan, China, Dutch East Indies, South Africa, and possibly Russia. While in New York he conferred with the members of the export division of the National Automobile Chamber of Commerce. Mr. Jones has submitted a report from Hawaii, and on June 30 was at Yokohama.

#### PAPER, PAPER PRODUCTS, AND PRINTING MACHINERY.

As a result partly of the interest in the South American markets displayed by the American Pulp and Paper Association, the Bureau made plans in the latter part of the fiscal year 1916 to send a representative to South America. For this purpose Robert S. Barrett, long a printer and publisher in Mexico and this country, was selected. His investigation includes news print, printing and writing paper, building and wall paper, miscellaneous paper products, printing processes, type, composing-room equipment, type setting and casting machines, bindery equipment and binders' cloth. Mr. Barrett spent a successful two months in this country conferring with presidents and managers of firms in the industry and discovered that they recognized the importance of export trade despite the then rather high prices in the paper industry and the strong domestic demand.

During 1917 Mr. Barrett studied the markets of Cuba, Panama, Ecuador, Peru, Bolivia, and Chile. His investigation has proved particularly timely because he has been able to explain to foreign merchants the reasons for the prevailing high prices in the paper and printing industries. The benefits from this investigation are expected to be more pronounced after conditions become more normal than at the present time. Markets for Paper, Paper Products, and Machinery in Cuba and Panama, Special Agents Series No. 132, 44 pages, was published during the year, as was Markets for Paper, Paper Products, and Printing Machinery, Special Agents Series No. 143.

#### RAILWAY EQUIPMENT, MATERIAL, AND SUPPLIES.

A study of the railway conditions in far eastern countries, notably Australia, New Zealand, China, Japan, and India, was undertaken by the Bureau, and Frank Rhea, an engineer of national repu-



tation, was selected for the work. Commissioner Rhea reported for duty in August, 1916, and after a careful survey of the foreign situation it was decided to have the tentative scope of the investigation include the following: (1) Railway equipment (motive power of all kinds, passenger and freight cars of all kinds, roadway machines, work equipment, wharf and dock and railway shop machinery, and roadway cars and tools); (2) railway materials (bridge materials, ties, rails, rail fastenings, frogs and switches, building materials, roadway materials, railway signal and interlocker materials, telegraph and telephone materials); and (3) railway supplies (repair and replacement parts for permanent way and all classes of equipment, operating supplies, and engineering supplies and tools).

The commissioner spent the greater part of the year in New Zealand, Australia, the Philippines, China, and Japan. In order to present the Australian and New Zealand situations in their proper light it was necessary for him to prepare virtually railway handbooks of these countries. This is a task never before undertaken, and his handbooks on these two countries will be a new departure in Government studies.

#### SHOES AND LEATHER.

Our manufacturers and merchants in the shoe and leather trades have expressed so keen an interest in securing specific information regarding foreign markets that the Bureau has undertaken two investigations, one in the Far East and one in Latin America. For the former Clarence E. Bosworth, from a shoe and leather trade journal, was selected as the investigator, and he has planned to obtain information relating to the production, use, and markets for raw hides and skins, tanning materials, tanning machinery, finished leather, finished boots and shoes, shoemaking materials, shoemaking machinery, harness leather, and finished saddlery. He left San Francisco in November, 1916, and has spent his time abroad chiefly in New Zealand, Australia, and the Philippines. He has been paying especial attention to new sources of supplies for leather products, hides, and skins.

The Latin American investigation was undertaken during the fiscal year 1916 by Herman G. Brock, a regular staff man, who devoted most of the fiscal year 1917 to the west coast countries of South America. His reports on Markets for Boots and Shoes in Cuba, Special Agents Series No. 133, 46 pages, and Markets for Boots and Shoes in Porto Rico, Special Agents Series No. 135, 28 pages, have been printed. His reports on Panama and Ecuador appeared in Commerce Reports.

#### TEXTILES.

As the most important associations in the textile trades expressed great interest in the Latin American markets, an investigation was undertaken with W. A. Tucker, formerly a mill superintendent and writer on textile subjects, in charge. He sailed in May, 1916, and during 1917 pursued his studies in the West Indies and the west coast of South America. His two published reports on Textiles in Cuba, Special Agents Series No. 126, 56 pages, and Textiles in Porto Rico

and Jamaica, Special Agents Series No. 137, 81 pages, are guides for American exporters. During May and June he extended his stay in Chile in order to complete the study of wearing-apparel markets in South America.

#### WEARING APPAREL.

The investigation of South American markets for wearing apparel, originally planned to be conducted exclusively by our commercial attachés, was finally placed under the supervision of Special Agents Brock and Tucker. This plan gives a uniformity to this investigation which would not otherwise be possible and is working out satisfactorily.

The Far Eastern markets for American wearing apparel have been made the object of a special study by Commercial Agent Stanhope Sams. This investigation was continued from the previous fiscal year. The greater part of his time during 1917 was spent in the Federated Malay States and Straits Settlements, Dutch East Indies, and Australia. The collection of samples covering the Japanese, Straits Settlements, Dutch East Indies, and Australian markets, which are now on exhibit in the sample room at the New York customhouse, is particularly interesting. The monograph submitted by Mr. Sams during the year was Wearing Apparel in Japan, Special Agents Series No. 130, 134 pages.

#### GENERAL ECONOMIC INVESTIGATIONS.

##### COMMERCIAL HANDBOOKS.

Garrard Harris had practically completed his travel in the West Indies during the fiscal year 1916 in connection with the preparation of the commercial handbook on these various islands. At the beginning of the fiscal year 1917 he was at La Guayra, and after spending a brief time at Trinidad and Tobago returned to this country. Mr. Harris, in his monograph of over 300 pages, entitled "West Indies as an Export Field," Special Agents Series No. 141, covers commercial and industrial conditions in Porto Rico, Jamaica, Santa Domingo, Barbados, Trinidad, Tobago, Haiti, and lesser islands. Mr. Harris is also the writer of Central America as an Export Field, Special Agents Series No. 113, 229 pages.

Because of the interest of the United States in the islands comprising the Danish West Indies group, Special Agents Brock, Smith, and Tucker, at that time stationed at San Juan on their respective investigations, were detailed by cable to proceed to these islands and make a report, to be published in the form of a handbook. They spent approximately a month at St. Thomas, St. Croix, and St. Johns. Special Agent Tucker returned to St. Thomas on October 12 in order to get supplementary information on the recent hurricane. Danish West Indies, Their Resources and Commercial Importance, Special Agents Series No. 129, 68 pages, treats of the following subjects: Geographical characteristics, government and education, public works and transportation, agriculture and allied industries, mineral resources, manufacturing industries, business conditions, foreign trade, market for boots and shoes, market for electrical goods, market

for textiles, and the hurricane of October 9. This report also describes in detail electrical and textile samples which are on display at the exhibit room of the Bureau at the New York customhouse. The monograph was timely and appeared over a month before March 31, the date upon which the United States formally took possession of the Danish West Indies islands. The demand for this publication was instantaneous, and up to April 27, 1917, 3,221 copies were sold.

E. A. Brand, first assistant chief of the Bureau until shortly before taking up his work as an investigator in the division of commercial agents, left for South America in April for a several months' trip. He has devoted his time equally between the west coast and the east coast of South America and is preparing commercial information relating to transportation facilities and living conditions in certain South American countries.

#### EXPORT MARKETING METHODS.

There is a great scarcity of information regarding methods of distribution in the export trade. The Bureau has recognized the distinct need of studying this exceedingly important phase of our foreign trade, and early in the fall of 1916 sent out a carefully prepared questionnaire to the district offices and the commercial attachés on this subject. Pertinent information was procured, but it was decided that in order to make any real coordinated comprehensive investigation it was necessary to secure the services of a specialist who would give this matter his entire attention. Prof. Paul T. Cherington, of the Harvard Graduate School of Business Administration, was selected for the work, and he reported for duty in June, 1917. This study is undertaken without any prejudice in favor of, or opposed to, any given merchandising method or methods and without any preconceived ideas about the value of any of these methods under various circumstances. Each fact will be tested and given full weight.

#### EXPORT PACKING.

The Bureau decided on a special study of the best methods of packing for export, not because our exporters were less proficient in this regard than the exporters of any other country, but because it seemed desirable to consider carefully the relation of packing to export trade; also to investigate any innovations that might prove a boon to our merchants if generally known. With this subject in mind, Grosvenor M. Jones, who is also conducting investigations on coal and ports and transportation facilities, visited numerous manufacturing plants in New York, Pittsburgh, Cleveland, Buffalo, Rochester, Utica, and other important business centers. He interviewed persons connected with export commission houses, forwarding agencies, trade associations, manufacturers' representatives, and others with reference to their experience—successes and failures and general difficulties—in packing goods for export shipment. As the result of these interviews he was able to secure practical and useful data as to good packing methods, and he was enabled thereby to plan the scope of the technical side of this investigation. His report as to essentials was practically completed before leaving this country,

but owing to his travel in South America he will be enabled to make interesting observations regarding the handling of cargoes and the manner in which the freight of all countries arrives at its destination.

#### INVESTMENT OPPORTUNITIES.

Two important investigations were started during the year relating to investment opportunities. One of these is conducted by Special Agent Halsey, financial statistics author of numerous publications on South America, and is devoted to South and Central America, and the other, dealing with the Far East, is in the hands of Trade Commissioner A. W. Ferrin, formerly editor of a financial magazine. The scope of these investigations is broad, and it is difficult to map out the work with any exactness. Briefly, the reports should include a short comprehensive survey of underlying conditions, which would serve as an introduction; Government, State, and municipal securities and finances; railway companies; public utilities; industrial companies; land, mining, oil, agricultural, timber resources, plantations, etc.; banking and insurance.

In carrying out the South American investigation it was decided that Mr. Halsey should visit Europe (England and France) preliminary to making the necessary trip to South America. As is generally known, Great Britain and France have long been the most important factors in the South American investment field, these countries having placed, it is estimated, over \$5,000,000,000 and \$2,000,000,000, respectively, in Latin American securities and enterprises. A majority of the important companies, under British and French control, operating in Latin America were visited by Mr. Halsey and a large number of reports and other official documents obtained, likewise a vast amount of information was gathered through conferences and studies.

He then visited Cuba, where, owing to disturbances, but little could be accomplished. Jamaica, Panama, Central America, Peru, Bolivia, Chile, Argentina, Uruguay, and Brazil were then visited in the order named. In these countries Mr. Halsey was able to largely verify by personal observation the information already obtained in Europe, also to secure detailed information concerning Government securities and finances and municipal securities. A number of enterprises not controlled in Europe were also investigated, and a large amount of data concerning mines, public utilities, etc., obtained. After leaving Brazil Mr. Halsey visited Barbados and the Windward and Leeward Islands, where he studied opportunities in sugar plantations, sugar factories, etc.

For the investigation of investment opportunities in the Far East, the Bureau appointed as trade commissioner Augustin W. Ferrin. He sailed in May, 1917, and intends to cover Japan and China and possibly certain other Far Eastern fields.

#### MINERAL RESOURCES.

One of the most technical investigations initiated by the Bureau was started during the present fiscal year when J. Morgan Clements was appointed to make a study of mineral resources in the Far East. This investigation may be looked at from many angles. The tenta-

tive scope of this investigation covers the following subjects: (1) A reconnoissance of the mineral districts in each country examined, and the preparation of a map showing distribution of the various districts, and in each case a statement of the general physical conditions which will guide our investors in sending out their own men for more intensive studies; (2) a study of the mining laws and conditions which make for or against security of investment and other fundamental factors which determine the investment of capital in mining enterprises; (3) a study of the trade conditions, transportation facilities, etc., which determine why raw materials—in this case ores—go from the Far East to Europe or Japan rather than to the United States; (4) a study of the operating mines and smelters, with a view to aiding in the introduction of American mining machinery and other supplies by informing American manufacturers, through the Department of Commerce, of opportunities for selling their machinery.

Trade Commissioner Clements made his first stop in Japan. His itinerary as tentatively decided on included Japan, Chosen, China, Indo-China, Siam, the Dutch East Indies, the Straits Settlements, Burma, east India, and west India.

#### PORTS AND TRANSPORTATION FACILITIES.

The Bureau began, in 1917, two investigations of ports and transportation facilities, one dealing with the Far East and the other with Latin America. The investigations cover ports and their equipment, railways, canal and river navigation, and also information in regard to road conditions. The studies are aimed (1) to provide the shipowners or operators and those interested in foreign trade full and reliable information in regard to the port and transportation facilities of the countries named; the data furnished to be such that the shipper may determine the ports through which he can most advantageously reach certain territories; also the best routing from there on to destination; (2) to present the needed and proposed port, railway, electric railway, canal, and river navigation extensions and improvements, particularly in China and Asiatic Russia, with the view of indicating opportunities for American investors, engineers, contractors, manufacturers, and dealers in port, railway, and construction and equipment appliances; matters relating to docks and warehouse construction; cold-storage warehouses; coal, ore, and grain-handling equipment; general freight-handling facilities; steam and electric railway construction and equipment, terminal buildings, etc., will be given special attention; (3) to present data and suggestions of a reference value to port authorities, engineers, and transportation men generally.

The investigation of conditions in the Orient is being undertaken by Paul P. Whitham, while that of Latin American conditions is in the hands of Grosvenor M. Jones.

The pilotage laws of the several States were made the object of a special study by Special Agent Jones during the fall of 1916. This involved an analysis of the statutes and regulations in force in these States which have legislation on the subject. The comparison of the various laws and regulations, which it is believed had never been made in any official report, brings out in an effective nonargumenta-

tive way the antiquated character and the unfair and discriminating nature of the laws of several of the States, as well as the almost total lack of Government control of pilot associations in many States.

#### PLANS FOR THE FISCAL YEAR 1918.

Of the investigations in progress at the close of the fiscal year 1917 the following will undoubtedly be completed within the ensuing 12 months: Far eastern investigations, agricultural implements, cotton goods and wearing apparel; Latin American investigations, boots and shoes, electrical goods, textiles, investment opportunities, special travel studies, paper, paper products, and printing supplies. The other investigations will proceed generally according to the plans as originally mapped out, except, of course, as changing conditions may make changes advisable.

The conditions of travel are becoming increasingly uncertain and many delicate problems have grown out of the war. During the coming year, however, it is hoped that new investigations may be started, particularly to the Far East and certain parts of Europe. Among investigations under consideration are the following: Construction materials and machinery in the Far East, mineral resources of Russia, machine tools in Russia, fibers, vegetable and textile grasses and their manufactures, and a general study of commercial laws and customs. European investigations will be concerned chiefly with reconstruction problems. The praiseworthy work of the United States Forest Service, American Red Cross, and other Government agencies in France shows the possibilities for extending the activities of the Bureau to stricken countries.

The Bureau has had a good many agents in Latin America, but among the subjects upon which our information regarding South America is meager may be mentioned the following: Chemicals and drugs; mercantile equipment and supplies for offices, banks, and stores; and vehicles of all kinds. When the time is ripe the Bureau should make special studies of the commercial and industrial conditions in Mexico.

The only new investigation definitely decided upon for the coming fiscal year is the advertising methods of South America. J. W. Sanger was selected to undertake this investigation and instructed to report for duty during July, 1917.

The Bureau feels the need of more investigations relating to our domestic trade. Among the subjects that may warrant special study are warehousing and general storage facilities and specific research into problems of factory management and marketing methods.

#### DISTRICT OFFICES.

District offices of the Bureau have been maintained during the entire fiscal year at New York, Boston, Chicago, St. Louis, New Orleans, San Francisco, and Seattle. One office—in Atlanta—was closed during the year.

#### FACILITIES AVAILABLE TO AMERICAN EXPORTERS.

These offices have on file the principal trade directories of the world, a complete set of the publications of the Bureau, and many journals devoted to the development of foreign commerce. They

have also the addresses of foreign merchants whose inquiries regarding trade connections with American merchants are published in Commerce Reports under the heading of "Foreign trade opportunities." Consequently the manufacturer or exporter in a distant part of the country is able to obtain these addresses immediately and is not subject to the delay that would be occasioned if he had to write to Washington for this information. Special lists of merchants in foreign countries are being constantly forwarded to the district offices and are kept on file for the information of all persons having a legitimate interest in the data. Many items that are of interest to only a few houses are not published in Commerce Reports or the other publications of the Bureau, but are sent to the district offices, which promptly bring them to the immediate attention of dealers or investors. Likewise many reports from consular officers that are not printed are sent to the district offices in manuscript form so that they may be consulted by houses that manufacture the articles discussed. Samples of merchandise of all kinds collected by the special agents of the Bureau investigating markets in foreign countries or transmitted by consular officers are circulated among the district offices in order that American manufacturers may have an opportunity to become acquainted with the prevailing styles that are likely to be in demand in markets abroad.

An important function of a district office is to furnish a place which the commercial attachés, commercial agents, trade commissioners, and special agents of the Bureau, American consular officers in the United States on leave of absence, and foreign buyers may use as headquarters in obtaining information regarding trade conditions in the United States or in disseminating data regarding opportunities for American trade abroad. The commercial agents in charge of the district offices know the manufacturers and exporters in their districts. Before the commercial attachés and special agents of the Bureau leave the United States they generally make a tour to the principal manufacturing centers that have an interest in the country to which they are assigned or in the products which they are to investigate. On their return they generally make a similar trip in order to advise manufacturers regarding the special conditions in foreign markets that can not well be explained in the printed reports. In this work the services of the district offices are invaluable, as the commercial agents in charge arrange for the necessary conferences and place the visitors in touch with the principal manufacturers with a minimum loss of time and effort. American consular officers traveling in this country make their headquarters at the district offices and are able to give valuable advice to American manufacturers. Foreign buyers seeking connections in this country have been especially appreciative of the facilities and assistance of the district offices. The attention shown to foreign buyers by the district offices has been one more modest factor in stimulating the foreign trade of the United States.

#### WAR WORK IN THE DISTRICT OFFICES.

Right at the close of the fiscal year an arrangement was made whereby the district offices were to assist in licensing such commodities as are placed on the controlled list by presidential procla-

mation. This is war work of an important character. It was clear that it would interfere with the ordinary routine of the branch offices for a few weeks at least, but there was no doubt of the value of the assistance that could be rendered through this arrangement.

#### EDUCATIONAL WORK.

The work of the district office is partly educational in so far as it consists in the diffusion of knowledge regarding trade conditions and trade opportunities. In most of the district offices the commercial agents give some academic work on foreign trade of a distinctly didactic character. In some cities the commercial agents are in charge of the foreign-trade courses given by established institutions of learning. Lectures are given to students, who are also encouraged to become familiar with the practical questions that arise in connection with the work of the office. In some cities the commercial agents are forming study clubs of business men and their clerks for the purpose of obtaining a better knowledge of the conditions affecting foreign trade. The greater part of this work is carried on in the evening, and it is gratifying to note that the commercial agents have assumed this extra burden enthusiastically in order to promote the development of foreign trade. The commercial agents in charge of the district offices watch the newspapers of their districts and are always ready to give authoritative information on questions that are of interest to the public. The educational work of the district office is by no means the least important of its activities.

#### EXTENSION OF THE WORK.

The work of the district offices may profitably be extended in certain directions when more funds are available. In most of the offices the force consists of the commercial agent in charge and one clerk; two offices have two clerks, and only one office (New York) has more than two. This arrangement does not allow the agent in charge to travel to the other cities in his district as frequently as would be desirable in order to interview and address interested manufacturers and promote public interest in the development of foreign trade. The work of this kind already done has proved worth while and has been appreciated. The Bureau should be excepted from the law which prohibits the expenditure of public money for attendance at meetings and conventions. Attendance at conventions is valuable, not only for the information our representatives can impart to the business men present but also for our men to acquire the point of view of industry in general. Business men find their trade conventions of great importance in the development of their business, and it seems advisable for the Bureau thus to keep in close touch with the interests it is organized to serve.

The present allowance for hotel and subsistence for men away from their station is \$4 a day. Authorization should be given to raise this to \$5 a day for travel in the United States, as so much of the work is carried on in large cities where it is impossible at present for the traveling agent to obtain suitable accommodations and meals for \$4.



## CHANGES DURING THE YEAR.

There have been more changes than usual during the past fiscal year in the personnel of the commercial agents in charge of district offices. This has been owing largely to resignations in order to accept better paying positions. It is always a source of regret to lose the services of an efficient and well-trained employee, but it is a tribute to the practical assistance being rendered by the Bureau when members of our staff are in demand for service in business concerns.

During the entire year the San Francisco and Seattle offices have been in charge of E. G. Babbitt and W. B. Henderson, respectively. The New York office was in charge of D. E. Casey until September 1, when he was transferred to the Washington office of the Bureau; E. M. Dillon was in charge until March 31, when he resigned to accept private employment; D. E. Casey again took charge of the New York office on April 7, and was in charge at the end of the fiscal year. The Chicago office was temporarily in charge of P. M. La Rose until August 1, when he was succeeded by N. L. Anderson; on April 24 Mr. Anderson was assigned to a position in the New York office and was succeeded by G. W. Doonan. The St. Louis office was in charge of Mr. Doonan until April 24, when he was placed in charge of the Chicago office; after April 24 the St. Louis office was temporarily in charge of T. L. Gaukel. The Boston office was in charge of W. A. Graham Clark until June 11, when he resigned to take a position on the Tariff Board; he was succeeded by Ansel R. Clark, previously in charge of the cooperative office maintained by the chamber of commerce of Portland, Oreg. The New Orleans office was in charge of J. F. Ferguson until September 1, when he was transferred to the Washington office; E. E. Judd was in charge of the office until April 16, when he was put in charge of the sample room at New York; Garrard Harris was in charge until May 3, when he resigned to take a position with the Committee on Public Information; Mr. Ferguson was again in charge of the office at the end of the fiscal year.

## COOPERATIVE OFFICES.

Cooperative offices are now maintained by the chambers of commerce in Philadelphia, Cincinnati, Cleveland, Portland (Oreg.), and Los Angeles, by the Greater Dayton Association, and by the Southern Railway at Chattanooga, and the Cincinnati, New Orleans & Texas Pacific Railway at Cincinnati. During the year the offices at Dayton and Portland were established and an office at Detroit was discontinued. The cooperative offices work along the same line as the district offices, but their activities are confined to the city in which they are located and the immediate vicinity. The cooperative offices receive the same material from the Bureau as the district offices, and are expected to do the same work in looking after foreign buyers, in arranging for visits by Bureau officials and consuls, and in giving advice and information to manufacturers seeking markets abroad. The cooperative offices are established with the understanding that one man will devote all his time to foreign-trade work, and that the office will be open to any American concern in the particular communities. The salary of this man is paid by the local organization,

but the man in charge must have training and experience that are satisfactory to the Bureau.

#### SAMPLE ROOM.

During the last year the sample room in the New York custom-house was equipped with tables and display frames sufficient to allow the displaying at one time of several hundred samples. The collections of hardware forwarded in connection with the series of reports on foreign hardware markets issued by the Bureau have been on display since late in the fall of 1916, and have constituted the major part of the exhibits in this room.

There have also been received and placed on display extensive collections of cotton goods from British India, China, Java, Straits Settlements, Cuba, and the Danish West Indies; electrical goods from New Zealand; wearing apparel from China, Java, Philippines, Chosen, Japan, Siberia, Straits Settlements, and Federated Malay States; boots and shoes from Australia; and paper and stationery goods from South America. All of these collections consist of samples sent in by the Bureau's special agents in connection with their reports on foreign markets for American goods. Toward the end of the fiscal year, however, plans were made for extending the work of this division by including samples of lines of goods which are of practical interest to American manufacturers that are not being covered by current investigations. To this end the Bureau's representatives in South America were authorized to expend considerable money on the purchase of samples ranging from cotton goods to jewelry.

The rapid increase in the number of samples made necessary the introduction of a special system for keeping track of the individual items similar to that in use in public libraries and museums. Each sample is now given a record number upon receipt in the sample room and properly indexed. Several hundred foreign catalogues have been indexed and filed in such a manner as to make them readily accessible for American manufacturers.

As the fiscal year closed, special trunks were obtained which will be used in shipping collections of samples to industrial centers throughout the country after they have been displayed in the New York office.

The sample division has furnished special exhibits at the following conventions during the past year: New York Electrical Exposition, New York, N. Y., October, 1916; Pittsburgh Foreign Trade Council, Pittsburgh, Pa., January, 1917; meeting of Chambers of Commerce of the United States, Washington, D. C., February, 1917; New York State Retail Hardware Association and Pennsylvania and Atlantic Seaboards Hardware Association, New York, N. Y., February, 1917; and Eastern States Industrial Exposition and Export Conference, Springfield, Mass., June, 1917.

#### COMMERCIAL ATTACHÉS.

During the fiscal year 1917 the administration of the commercial attaché service has been carried on by three employees of the Bureau, who constitute the commercial attaché division. It has required some

"doubling up" for the Bureau to detail employees for this important work, which requires close and intelligent attention. When Congress appropriated funds for the commercial attaché service, it made no provision for the administrative work in Washington, a situation which should be remedied by legislation.

That the commercial attaché service is fulfilling its mission is indicated by the communications received by the Bureau from American business men, both at home and abroad, as well as from our diplomatic representatives. During the last year requests for the establishment of commercial attaché posts have been received from our ambassadors to Italy, Japan, Spain, Mexico, and the consul general at Calcutta, India. The American Association of Japan made a similar request, as did the American Chamber of Commerce in Italy. American business men who have been in touch with the commercial attaché service in the course of their travels have expressed to the Bureau their appreciation of the valuable and timely aid rendered by the attachés.

It should be emphasized that the work done by the commercial attachés is separate and distinct, supplementing rather than duplicating the work being done abroad by the diplomatic service or our own traveling agents.

#### MOVEMENTS OF ATTACHÉS AND PERSONNEL CHANGES.

It was possible this year to bring several of the attachés back to this country. Such a trip serves two purposes: It enables American manufacturers and exporters to receive at first-hand the benefit of the attaché's experience and observations, and it enables the attaché to get a new vision of commercial conditions in this country and to ascertain in just what way he can best serve the needs of the Bureau's clientele.

An important visit of this kind was that of Commercial Attaché Julean Arnold, of Peking. Mr. Arnold left his post in September, 1916, and returned to Peking in May, 1917, after a trip which included every section of the United States. Commercial Attaché Erwin W. Thompson, temporarily at The Hague, was absent from his post from August, 1916, until February, 1917. Commercial Attaché Albert Hale left Buenos Aires in August and was in the United States until his resignation on December 31, 1916. Commercial Attaché Pierce C. Williams, at London, returned to the United States in August, 1916 for several months. Verne L. Havens, attaché at Santiago, arrived here in February and remained until the end of the fiscal year.

There were few changes in the personnel of the attaché service during the year. Dr. Albert Hale resigned his post at Buenos Aires in December, 1916. At the end of the fiscal year this post had not been filled. Resignations and new assignments of clerks to attachés were frequent.

#### NEW OFFICE AT TOKYO.

After giving the matter careful consideration, a commercial attaché has been assigned to Japan. To make this long-desired move possible one of the offices on the west coast of South America was

closed, the work there now falling to the attaché at Lima, Peru, and the attaché at Buenos Aires.

In April, 1917, Dr. Frank R. Rutter, formerly Assistant Chief of the Bureau, was appointed to fill the new post at Tokyo. After spending some time visiting industrial centers in this country, Dr. Rutter sailed for Japan in the early part of June. It is believed that the present arrangement will prove a benefit to our commercial interests and that the appropriation made by Congress will be used to the best advantage in this manner.

#### SPECIAL INVESTIGATIONS.

Continuing the use of the methods evolved last year in the hardware investigation, the commercial attachés in South America have made during the year an intensive study of the markets for wearing apparel. Each attaché was allotted funds for the employment of an expert to prepare, under his supervision, a report on the local markets. Funds were also provided for the purchase of a number of illustrative samples. This investigation was being finished at the close of the fiscal year. The samples, together with current information as to prices, sizes, etc., will be made available to American manufacturers, first at the sample exhibit room in New York and then throughout the country.

Another special investigation made in South America concerned the possibilities of extending American fire insurance business on that continent. This study was made at the suggestion of the National Board of Fire Underwriters, whose membership includes most of the important companies writing fire insurance. Acting upon the data thus provided, American fire insurance companies will be in a position to determine the advisability of entering this field.

#### GENERAL INVESTIGATIONS.

The most important and far-reaching investigation yet undertaken through the commercial attaché service is that relating to the establishment of American banks abroad and the investment of American capital. A good beginning in foreign branch banking has been made by a few of our banks and express companies, and we are glad to assist them in expansion for the benefit of American commerce.

Linked with the subject of banking is that of investing capital. No small part of the success of our foreign commercial competitors has been due to large investments in industrial and commercial enterprises, particularly in newly developed regions. In order to furnish American capital with at least the preliminary information needed before such investments can be considered, the attachés are now making a study of their particular fields.

#### WORK IN EUROPE.

In London war conditions made extensive promotive work out of the question. Commercial Attaché Pierce C. Williams kept the Bureau fully advised as to the various changes affecting our trade, and

his office was able to assist business men with reference to British import and export regulations. The attaché made a study of England's war-trade organization that proved of value to the Bureau and this country. Mr. Williams returned here during the fall, and after visiting the commercial centers of the East, South, and Middle West made his headquarters in Washington. Upon the outbreak of the war Mr. Williams was able, through his knowledge of the English system, to draft the plans for the Bureau's war-trade activities. Later this attaché was able to assist in coordinating the efforts of this Government and our allies.

Commercial Attaché William C. Huntington, at Petrograd, started early in August, 1916, for a trip through European Russia that included practically every important Russian trade center, returning to Petrograd early in October. His knowledge of the Russian language proved valuable in commercial negotiations, and especially during the days of the Russian revolution. The last year was largely one of study of Russian commercial conditions, establishing acquaintanceship and rendering personal service to American business men. Dr. Huntington continued negotiations through the Embassy for the release of Russian commodities needed in the United States.

At Paris Commercial Attaché C. W. A. Veditz worked under war conditions, but was able to do a considerable amount of trade-promotion work as a result of the shortage in many lines which could be supplied from the United States. He was successful in inducing the French Government to permit a large machinery house to continue its operations in France, the firm representing about 60 of the leading industrial machinery makers in the United States. This achievement alone probably saved \$2,000,000 of business annually for the American manufacturers.

The attaché traveled through France with the American Industrial Commission that investigated economic and commercial conditions. He kept in close touch with the reconstruction problems that France must face after the war, and in order to gain first-hand information has, through the courtesy of English and French officials, visited the devastated regions in northern France and Belgium. Of especial note is the aid rendered by Dr. Veditz to the quartermaster corps of the American Expeditionary Forces; through his knowledge of the French markets the attaché was able to render timely aid and advice as to the purchase of materials and supplies. Just before the close of the year the attaché was designated by the American Ambassador to represent this Government at important interallied conferences and committees.

Commercial Attaché Erwin W. Thompson continued to make The Hague his headquarters until February, 1917. He returned to the United States in September, 1916, and immediately started on a trip that included the important trade centers in the East, North, South, and Middle West. Besides addressing commercial bodies, Mr. Thompson held personal conferences with manufacturers and exporters interested in his territory. He was able to assist the California olive-oil industry, upon which subject he is an expert. It was intended that he would make his headquarters at Berlin upon his return to Europe, but on our entrance into the war he was temporarily assigned to Copenhagen, Denmark.

## WORK IN SOUTH AMERICA.

Commercial Attaché Albert Hale returned to the United States in August, 1916, and after visiting the principal centers interested in trade with Argentina, resigned from the service. Lew B. Clark, the clerk at that post, has been in charge of the office during practically the entire year. Besides conducting the wearing-apparel investigation and attending to the purchase of samples, Mr. Clark has kept the Bureau informed of important trade changes in his territory. Plans are now under consideration for filling this important post at an early date.

William C. Downs, commercial attaché at Rio de Janeiro, besides making the special investigation already referred to, paid special attention to financial matters. The attaché forwarded several reports on investment opportunities, one of which resulted in a loan of \$5,000,000 in this country. Early in the year Mr. Downs was designated a member of the Return Visit Committee to Brazil. Besides assisting the committee in making their arrangements he helped to formulate the committee's report and traveled with it to Sao Paulo and other Brazilian trade centers. Mr. Downs's office is now in the heart of the business district of Rio de Janeiro.

William F. Montavon, commercial attaché at Lima, was also a member of the Return Visit Committee to Peru and Bolivia and traveled with the committee. Conditions in this district were favorable for trade promotion, and as a result of the attaché's activities initial shipments of several classes of American merchandise were made to Peru. While in Bolivia Mr. Montavon made a study of the possibility of Government purchases of railroad supplies and equipment from the United States, with the result that purchases were made in the United States. Mr. Montavon has been investigating Peruvian fibers in cooperation with the Department of Agriculture.

Verne L. Havens, commercial attaché at Santiago, Chile, was instrumental in having the American Society establish a commercial section for the furtherance of mutual trade relations between Chile and the United States. A short time before returning to this country he visited Buenos Aires; while there he investigated certain common complaints against American trade, reporting that rumors regarding such complaints had been exaggerated. The attaché was on leave of absence at the close of the fiscal year.

## WORK IN THE FAR EAST AND AUSTRALIA.

While Commercial Attaché Julean Arnold was not at Peking for more than three months during the year, his travels throughout all sections of the United States were especially productive. He addressed a large number of trade organizations, illustrating his talks with lantern slides. As definite results of his efforts, clubs for the furtherance of trade development in China were started in Seattle, San Francisco, and Chicago; also, many manufacturers decided to visit China to study the opportunities for trade expansion. During Mr. Arnold's absence, John R. Arnold, from the Bureau's staff, was in charge of the office and devoted a portion of his time to collecting material for more specialized work in the Bureau on far eastern

affairs. To this end he traveled in China and Japan before returning to the United States.

At Melbourne Commercial Attaché Philip B. Kennedy put in an important year. Previous to America's entrance into the war there existed a certain amount of unfavorable opinion on our nonparticipation in the great struggle. In the face of this the attaché made addresses before chambers of commerce and similar bodies, speaking constructively on trade matters of local importance and keeping American commercial interests in their true light. Although war conditions interfered seriously with several trade matters which he had helped to perfect, his success in introducing Australian purchasers to American sources of supply and in mediating in commercial disputes has been commendable.

#### NEED FOR ADDITIONAL ATTACHÉS.

The results which have been attained during the three years since the establishment of the commercial attaché service amply justify its extension. At present certain large and important markets for American products are inadequately covered. Other sections are not covered at all. It is my opinion that additional attachés should be appointed to cover the following countries and regions: Italy, Mexico, South Africa, India, Venezuela, Colombia, the West Indies, Central America, and Spain, and possibly eventually Scandinavia, Holland, Switzerland, the East Indies, and the eastern Mediterranean region. With a fair and sensible enlargement of the service the Bureau would be able to have its resident representatives in the most important centers of the commercial world and to render increasingly effective service to American exporters.

#### LEGISLATIVE NEEDS.

In addition to the pressing need for legislation to provide for an administrative staff in Washington, there are two other salient defects which require legislative correction, as follows: (1) The removal of the legislative restriction that forbids the employment of more than one clerk at a time at a salary not to exceed \$1,500 per annum; (2) the allowance of additional funds for travel. These changes are indispensable to the service.

To secure the maximum results from the service, the attachés should be permitted to employ additional clerical assistance, at least when a clerk has resigned or is absent on leave. As it is now, the attaché has no clerical help for periods varying from two to six months while a successor is being found, appointed, and sent to his post. Legislation is also suggested to remove the salary restriction of \$1,500 per annum. This salary was inadequate at some posts even before the war. Now it is almost impossible for a clerk to live on that salary, particularly at Petrograd, Peking, Buenos Aires, and Rio de Janeiro. There have been six resignations presented to the Bureau by clerks to commercial attachés during the year. When the cost of recalling one clerk and the expense of sending out another is considered, it would seem economical to authorize an increase in the salary of clerks to \$2,250 to insure a reasonable tenure in office. As an alternative, post allowances, such as are provided for our diplomatic and consular officers, should be authorized by legislation. The expendi-

ture of funds for other personal services, such as janitor service, should likewise be authorized. Hindrances of the kind indicated are distressing and unnecessary.

If legislation can be secured to remedy the present deficiencies it is believed that the Bureau will soon have a foreign-trade promotion service unsurpassed by that of any other nation.

### **LATIN AMERICA.**

A division such as the Latin American division may concern itself with an elaboration of the routine work of the Bureau relating to Latin America—collecting and distributing information—or it may initiate and carry to completion projects for the encouragement and development of Latin American trade or for the removal of obstacles to such trade. The division attempts work on both these lines, but in practice it has been found advisable to consider the first as the more important and to take up new projects only when sufficient time is left from the performance of the less spectacular but more necessary routine work.

While outside organizations and business firms usually show themselves sympathetic toward proposals for such projects by the Bureau, in nearly all cases they expect the Bureau to assume the burden of carrying them to completion, and our force has been too limited to permit us to undertake much extensive new work. The division accordingly devoted most of its time during the fiscal year 1917 to accumulating data of all kinds relating to economic conditions and business practice in Latin America, classifying the information, and making it available to American firms asking assistance, either through publications or correspondence or in the course of personal inquiries at the Washington office. Every effort was made to answer inquiries by mail or telegraph fully, and in cases where no information was found the inquirer was advised where he might apply for it. Much time was also given to discussing with visitors their special problems in Latin American trade, and the division has taken pains to see that each visitor received not only what data there were on hand but such help in the way of advice and suggestions as could be given. The letters of thanks received indicate that this service is appreciated.

The division reached the public through contributions to various periodicals, mostly trade papers, dealing with Latin American trade opportunities or the assistance which the Bureau offers to exporters. This is a feature which will expand in the future. Such articles, however, require considerable time for preparation, must be authoritative and of solid value.

### **COMPILATION AND DISSEMINATION OF SPECIAL INFORMATION.**

The requests for information on Latin America cover a wide range of subjects, many of them relating to the markets for minor articles such as certain brands of tooth paste or automobile accessories. It is accordingly necessary to obtain as detailed facts and figures as possible and to utilize for this purpose all available sources of information. Files of consular reports and reports from special agents and commercial attachés form the chief reservoir from which we draw, but it is desirable to supplement these with notes and articles from



outside publications. In the last two or three years there has been a notable increase in the amount of literature published on Latin American subjects, and periodicals have carried "stories" and figures that are not only of current interest but of value for future reference. In order to keep this material from being lost and to build up another source of information the division has established a card index in which a record is kept of articles appearing in standard periodicals (not including those listed in Poole's Index and similar guides), which would be at all likely to be of service to us in handling inquiries on commercial or related subjects. These periodicals are then filed either in the Latin American division or in the library of the Department, where they can be readily consulted. Included in the list of publications so indexed are several from Latin America, and these afford a valuable record of the economic life of Latin America. For the most part they cover South America or parts of that continent only, and it is to be regretted that there is much less current literature of this kind on Central America, Mexico, and the West Indies. In addition to periodicals the division searches new publications in book and pamphlet form. Over 500 pamphlets and books in Spanish and Portuguese, mostly official reports of the Governments of Latin American countries, have been indexed and filed. The division maintains another file, in which clippings of various kinds, from periodicals which it is not necessary to preserve, newspapers, official gazettes, etc., are classified under appropriate headings. Copies of memoranda sent to inquirers, reports from field agents and attachés not suitable for publication, and miscellaneous material are kept in this file.

Altogether there are 65 periodical publications on our list. From these notes and articles are prepared for publication each week in Commerce Reports, and others are clipped and filed. Figures compiled from the *Diario Oficial* of Uruguay furnished material for a review of Uruguay's commerce for 1916, which would not have been obtainable from the official annual statistics of Uruguay for perhaps a year.

Other material which has been collected includes several maps, directories published in South American countries, statistical publications, and lists of commercial houses, etc. Among other data, material for a sort of directory of American houses represented in South America has been collected, several lists having been received from South America, with more to follow. With lists of houses permanently represented in Latin America the Bureau can obtain a much quicker response and more effective cooperation in new projects.

The Latin American division, of course, works in full cooperation with the other offices of the Bureau engaged in activities concerning Latin America, particularly the trade information section, the division of commercial attachés, and the division of commercial agents.

Detailed instructions were prepared for an elaborate investigation through the offices of the commercial attachés into the markets for wearing apparel in South America, which is discussed elsewhere in this report. Toward the close of the fiscal year instructions were also drawn up in this division for the purchase of a large collection of samples by the attachés, representing the classes of goods of various kinds sold in South America by competitors of the United States.

These projects were worked out in detail before the instructions were sent, and they are expected to provide an exhaustive review of the wearing-apparel market in the one case and a notable addition to the sample collection in the other.

The division has also devoted special attention to the appointment of new special agents on Latin American investigations and assists the agents after appointment with regard to itineraries, etc. Every effort is made to have the field work supplement the office work and the office work supplement the field work.

#### PROMOTION OF COMMERCE WITH MEXICO.

Although South and Central America have constituted the chief field of activity in Latin America among United States exporters, there has been a great deal of latent interest in Mexico, as evidenced by inquiries received whenever events in that country indicated that peaceful conditions were being restored. It is realized that Mexico is one of the richest and most promising countries with which the United States can cultivate trade relations, and that the years of disorder and the consumption and destruction of existing stocks of manufactured goods will mean a heavy demand for many kinds of factory products as soon as the country returns to normal conditions. The Bureau has constantly kept in touch with the Department of State in following the revival of business activities in Mexico and assisting American firms in determining the proper time at which to attempt to resume commercial relations with that country. After the return of the American Ambassador and the reopening of several consulates in Mexico these sources of information were utilized and American interests were advised to apply to the consular officers direct for details regarding the demand for their lines. It is felt, however, that a general commercial review by a competent business observer traveling over the whole country will sooner or later be advisable. If it is found later that such an investigation can be conducted the agent will visit all the chief centers, and his reports will be made immediately available to American firms wishing to see them. Pending such an investigation the Bureau will get what data it can from the consular offices and from publications from Mexico.

#### COOPERATION WITH TRADE ORGANIZATIONS.

Attempts have been made, with considerable success, to interest trade organizations in working with the Bureau to advance our Latin American trade, and there is opportunity to focus the efforts of such bodies and of large commercial firms with representation in Latin America on trade-development plans that can not be worked out by individuals. For example, there are at present both a need for good roads throughout Latin America and a real interest on the part of the inhabitants of certain countries in providing them. At the same time there is a lack of public funds and of knowledge as to the comparative expense and durability of the various kinds of paving such as are used in the United States for country roads, and a scarcity of raw materials and of the latest road-making machinery. Coordinated effort on the part of American manufacturers of this ma-

chinery, paving material producers, motor-car and motor-truck manufacturers, etc., to adopt a plan of demonstration of road building in various countries of Latin America would promise benefits to all concerned. The building of good country roads in South America would be stimulated, and the practical benefits that come to the farmer and ranch owner from better access to railroads and markets would be more fully realized. The building of such systems of good roads would make possible the extensive use of motor trucks in transporting farm products, and the range of pleasure cars, now as a rule confined to the larger cities, would be greatly increased. A plan of cooperation among the varied American business interests by which the results mentioned might be obtained was taken up with several firms, but the war business and the demands on our engineers have to date been sufficient to delay action on this line.

Other Latin American matters in which the Bureau is actively participating include the preparation of pamphlets containing directories of United States firms in each of a number of industries for distribution throughout Latin America; action to make available to the United States the stocks of cattle in Caribbean countries which have heretofore been kept out of this country largely because of the prevalence of cattle tick, which can be removed effectively by careful dipping; cooperation with the Office of Markets and Rural Organization in the Department of Agriculture in carrying on foreign investigation work; and assisting foreign students to attend universities in the United States and obtain practical shop experience after graduation. At the close of the fiscal year arrangements were made with a well-known authority on Latin American subjects to compile an elaborate handbook for commercial travelers to South America, which will become available sometime during the fiscal year 1918. The large number of inquiries received from farmers regarding agricultural conditions in South America and the prospects for homesteaders made it seem advisable to get out a monograph on the subject, and much material was gathered and is awaiting editing for publication.

The Latin American division has had the supervision of the work of the three resident commercial agents of the Bureau in the island possessions of the United States, Porto Rico, Hawaii, and the Philippines. These agents receive a small salary, and in return devote a part of their time to Bureau work. A list of subjects for reports has been sent to each agent and each one was also instructed to render an annual report reviewing conditions in his district in 1916.

In its future work, considering the existing and prospective international situation, the division will probably concern itself with the following lines of activity: (1) Continuing and expanding the present work of collecting and classifying information on all commercial subjects, conferring with visitors, engaging in research work, and answering fully all Latin American inquiries; (2) cooperating in every way possible with the Bureau of Export Licenses and otherwise assisting in the prosecution of the war; (3) establishing and carrying out a definite program of education, in both Latin America and the United States, to bring about a closer acquaintanceship between the business interests of the two sections and assist in forming connections and straightening out misunderstandings; (4) compiling

special publications for reference and other purposes; (5) making preparations, as definite as possible, for meeting competition after the close of the war; and (6) assisting in building up our trade with Mexico.

### FOREIGN TARIFFS.

Trade restrictions in belligerent and certain neutral countries formed the most prominent feature of the work of the division of foreign tariffs during the year in regard to both publication and correspondence. Most of the information on that subject is now received in the form of cables and immediately published in Commerce Reports. Requests for information in regard to such restrictions have to a large extent taken the place of requests for regular tariff information.

The division contributed about 200 pages to Commerce Reports, and this material was reprinted in pamphlet form as Foreign Tariff Notes, Nos. 11 to 25; in view of the frequent changes in trade restrictions of various kinds the publication of Foreign Tariff Notes involves much more work than formerly.

Four special reports were completed during the year under the following titles: Commercial Travelers in Latin America; Supplement to Foreign Import Duties on Motor Vehicles and Accessories; Supplement to Consular Regulations of Foreign Countries, Canada and Latin America; and Customs Tariff of Chile. The last named was in press at the close of the year.

Embargo legislation and other trade restrictions in belligerent and neutral countries are perplexing subjects to the American manufacturer and exporter, and the division of foreign tariffs has made a feature of supplying accurate and detailed information of this kind. Embargo legislation is complicated by the numerous changes which take place almost daily and by the number of countries involved. The Bureau of Foreign and Domestic Commerce is probably the only place in the United States where practically complete information on the subject is made available to the general public.

The correspondence in connection with foreign trade-mark legislation shows a gratifying increase. A new feature connected with that work has been introduced in calling the attention of American manufacturers to attempts at registration of their marks in certain Latin American countries where registration and not use determines ownership. This new service of the Bureau is evidently appreciated by American manufacturers, as shown in their letters. The work could be extended if facilities permitted.

### RESEARCH.

The general work of the research section during the fiscal year 1917 consisted largely, as in previous years, in compiling foreign statistics and making translations from foreign languages into English. As heretofore, the Statistical Abstract of the United States, and the pamphlet, Wholesale Prices (completing a continuous weekly record from September, 1893, to the date of issue), were compiled, and certain special work was undertaken.

The regular force consisted of four regular employees. Mr. Parker, who entered the Bureau through a civil-service examination for ex-

pert in commerce and finance, July, 1916, assumed control of the section shortly after his arrival, but was transferred to the division of export licenses near the end of the fiscal year, and arrangements were completed to have James A. Robertson, of the research department of the Carnegie Institution, take charge of the section at the beginning of the coming fiscal year.

Special work, in addition to that above mentioned, consisted of compilations for the principal yearbooks, domestic and foreign, newspapers, and trade almanacs; the practical completion of the tables for about 40 of the principal cotton-manufacturing countries of the world, which have been turned over to the division of statistics for conversion of the foreign figures and values into equivalents of the United States; a questionnaire regarding foreign investments, which was sent to bankers throughout the country, and which resulted in a fair number of replies; various special reports, the most important of which were several on natural monopolies; and reports on values in foreign trade; cost, scope, and methods of the proposed investigation of European lumber markets; Brazilian finances, and those of other South American countries; revenues, expenditures, debts, and loans of the belligerent nations; Chinese railroads; iron industry in China; European waterways; excise taxes on sugar in European countries; navigation policies in France; German organization of export trade; traffic on European canals; and earnings of the navigation companies of Germany. Commercial Agent A. H. Oxholm was assigned to the section for a short period to prepare, under Mr. Parker's supervision, a report on the export lumber trade of the United States.

A file was started for photostat copies of tables compiled from foreign reports or other matter prepared in this section in answer to specific inquiries, in order that these may be readily available for similar requests—an innovation that has been most useful, in view of the fact that requests for special reports have been fostered by the publication of the titles of the most important in Commerce Reports.

The work of the section assumed a wider scope after the declaration that a state of war existed between this country and Germany, and indications are that the work will continue to increase even more rapidly than in the past. As the demand for information on the statistics and trade of foreign countries is in greater demand than ever, it will be necessary to increase the technical force by one or two good translators during the coming fiscal year. If possible, the Statistical Abstract of Foreign Countries, discontinued some years ago, will be revived.

#### EDITORIAL DIVISION.

The work of the editorial division was about the same in volume as during the preceding year, although the number of special publications increased and the actual amount of editorial work performed exceeded that of any previous year. This resulted from the policy of publishing reports from the commercial and special agents as promptly as possible after their receipt, rather than holding them so as to include reports for several countries in one volume. Another factor was the increase in the field force of the Bureau. That the work has been handled with a fair degree of promptness may be

attributed partly to the fact that better trained agents are being employed for investigations and to the fact that greater efficiency has been achieved in the editorial division itself.

The following table presents a summary of the publications issued by the Bureau during the last three fiscal years. All of these, excepting the purely statistical publications and those on foreign tariffs, were handled by the editorial division.

## PUBLICATIONS ISSUED DURING THE FISCAL YEARS ENDED JUNE 30, 1915 TO 1917.

Publication.	1915		1916		1917	
	Number.	Pages.	Number.	Pages.	Number.	Pages.
Commerce Reports.....	306	5,904	307	5,328	306	4,896
Supplements to Commerce Reports.....	74	1,082	129	1,864	107	1,735
Index to Commerce Reports and supplements.....	4	155	5	254	5	217
Special consular series.....	8	1,266	2	196	1	12
Special agents series.....	15	930	18	1,636	27	2,344
Miscellaneous series.....	6	995	13	2,573	24	2,752
Monthly Summary of Foreign Commerce..	12	1,088	12	1,045	12	1,104
Commerce and Navigation.....	1	907	1	974	1	960
Statistical Abstract.....	1	720	1	749	1	773
Other statistical publications.....	28	649	29	320	29	412
Tariff series.....	3	57	4	159	3	66
Foreign Tariff Notes.....	3	102	4	179	4	192
Confidential bulletins.....	12	115	1	7	1	42
Annual report of Chief of Bureau.....	1	17	1	75	1	97
Sailing dates of steamships.....	5	68				
Catalogue of Bureau publications.....			1	47	a 1	4
Monthly Letter.....	3	59	13	289	12	192
<b>Total.....</b>	<b>482</b>	<b>14,115</b>	<b>541</b>	<b>15,705</b>	<b>536</b>	<b>15,788</b>

a Supplement to catalogue.

During the year there were prepared and published a series of 10 bulletins on the foreign markets for American hardware. These reports were written by specialists in foreign countries under the supervision of the commercial attachés.

A supplement to the Bureau's catalogue of publications was issued in order to keep it up to date. During the coming year it is planned to have the catalogue thoroughly revised.

Owing to the return of Commercial Attaché Julean H. Arnold to this country to make a tour of the more important commercial districts, the Bureau did not issue the contemplated handbook on China. With the return of the commercial attaché to China the work on this handbook will be completed, and it is expected that it will be published during the coming fiscal year.

The following list gives the titles of the monographs handled during the year:

## SPECIAL AGENTS SERIES.

No. 119. Government Aid to Merchant Shipping, by Grosvenor M. Jones; 265 pages. Price 25 cents.

No. 120. Cotton Goods in the Dutch East Indies, by Ralph M. Odell; 55 pages. Price 10 cents.

No. 121. Artificial Dyestuffs Used in the United States, by Thomas H. Norton; 254 pages. Price 30 cents.

No. 122. Development of an American Linen Industry, by W. A. Graham Clark; 23 pages. Price 5 cents.

- No. 123. Cotton Goods in Ceylon, by Ralph M. Odell; 89 pages. Price 5 cents.
- No. 124. Cotton Goods in British India; Part I, Madras Presidency, by Ralph M. Odell; 50 pages. Price 10 cents.
- No. 125. Markets for Agricultural Implements and Machinery in Argentina, by Frank H. von Motz; 86 pages. Price 10 cents.
- No. 126. Textiles in Cuba, by W. A. Tucker; 56 pages. Price 10 cents.
- No. 127. Cotton Goods in British India; Part II, Bengal Presidency, by Ralph M. Odell; 88 pages. Price 10 cents.
- No. 128. Electrical Goods in Cuba, by Philip S. Smith; 40 pages. Price 5 cents.
- No. 129. The Danish West Indies, by H. G. Brock, Philip S. Smith, and W. A. Tucker; 68 pages. Price 15 cents.
- No. 130. Wearing Apparel in Japan, by Stanhope Sams; 134 pages. Price 15 cents.
- No. 131. South American Markets for Fresh Fruits, by Walter Fischer; 163 pages. Price 25 cents.
- No. 132. Markets for Paper, Paper Products, and Printing Machinery in Cuba and Panama, by Robert S. Barrett; 44 pages. Price 5 cents.
- No. 133. Market for Boots and Shoes in Cuba, by Herman G. Brock; 46 pages. Price 5 cents.
- No. 134. Electrical Goods in Porto Rico, by Philip S. Smith; 16 pages. Price 5 cents.
- No. 135. Market for Boots and Shoes in Porto Rico, by Herman G. Brock; 28 pages. Price 5 cents.
- No. 136. Pilotage in United States, by Grosvenor M. Jones; 102 pages. Price 15 cents.
- No. 137. Textiles in Porto Rico and Jamaica, by W. A. Tucker; 31 pages. Price 5 cents.
- No. 138. Cotton Goods in British India; Part III, Burma, by Ralph M. Odell; 52 pages. Price 10 cents.
- No. 139. Market for Construction Materials and Machinery in Cuba, by W. W. Ewing; 61 pages. Price 10 cents.
- No. 140. Markets for Agricultural Implements and Machinery in Brazil, by Frank H. von Motz; 59 pages. Price 10 cents.
- No. 141. West Indies as an Export Field, by Garrard Harris; 378 pages. Price 50 cents.
- No. 142. Markets for Agricultural Implements and Machinery in Chile and Peru, by Frank H. von Motz; 48 pages. Price 5 cents.
- No. 143. Paper, Paper Products, and Printing Machinery in Peru, Bolivia, and Ecuador, by Robert S. Barrett; 77 pages. Price 10 cents.
- No. 144. Market for Construction Materials and Machinery in Venezuela, by W. W. Ewing; 57 pages. Price 10 cents.
- No. 145. Market for Boots and Shoes in Jamaica, by Herman G. Brock; 24 pages. Price 5 cents.

## SPECIAL CONSULAR REPORTS.

- No. 76. Proprietary Medicine and Ointment Trade in China, by Thomas Sammons, consul general at Shanghai, China; 12 pages. Price, 5 cents.

## MISCELLANEOUS SERIES.

- No. 88. Trade of United States with World, 1914-15; 247 pages. Price 20 cents.
- No. 39. Peruvian Markets for American Hardware; 64 pages. Price 10 cents.
- No. 40. Consumption Estimates, Production, Imports, and Exports; 12 pages. Price 5 cents.
- No. 41. Markets for American Hardware in Chile and Bolivia; 190 pages. Price 25 cents.
- No. 42. Australian Markets for American Hardware; 105 pages. Price 10 cents.
- No. 43. Markets for American Hardware in Argentina, Uruguay, and Paraguay; 64 pages. Price 10 cents.
- No. 44. Trans-Pacific Shipping; 30 pages. Price 5 cents.
- No. 45. Exporting to Australia; 29 pages. Price 5 cents.
- No. 46. Russian Markets for American Hardware; 111 pages. Price 15 cents.
- No. 47. Brazilian Markets for American Hardware; 89 pages. Price 15 cents.

No. 48. Markets for American Hardware in Germany, the Netherlands, and Scandinavia; 126 pages. Price 15 cents.

No. 49. Markets for American Hardware in France, Algeria, and Morocco; 61 pages. Price 10 cents.

No. 50. Far Eastern Markets for American Hardware; 145 pages. Price 25 cents.

No. 51. Lumber Markets of Mediterranean Region and Near East; 81 pages. Price 5 cents.

No. 52. Wholesale Prices of Leading Articles in United States Markets, January, 1914-December, 1916; 14 pages. Price 5 cents.

No. 53. Cane Sugar Industry; 462 pages. Price 50 cents.

No. 54. Canned Foods; 79 pages. Price 20 cents.

No. 55. Markets for American Hardware in Italy, Spain, and Portugal; 109 pages. Price 15 cents.

No. 56. Consumption Estimates, Production, Imports, and Exports; 14 pages. Price 5 cents.

No. 57. German Foreign-trade Organization; 182 pages. Price 20 cents.

No. 58. Cotton Textiles; 19 pages. Price 5 cents.

No. 59. Methods of Computing Values in Foreign-trade Statistics; 23 pages. Price 5 cents.

No. 60. The Glass Industry; 480 pages. Price 35 cents.

No. 61. Commercial Organizations of the United States; 116 pages. Price 15 cents.

Each issue of Commerce Reports was limited to 16 pages and this decreased by about 400 the total number of pages published during the year. Fewer Supplements to Commerce Reports were issued, but the number of pages was about the same as the preceding year. Toward the close of the year 1916, in accordance with the policy adopted by the State Department, the Bureau ceased to publish the annual reports from belligerent countries.

During the year 3,135 foreign trade opportunity notices were published in Commerce Reports, as compared with 4,300 in the preceding year. With the increased restrictions thrown about the international trade of the belligerent countries there was less opportunity for the consular officers to obtain and submit trade opportunities. The Bureau observed the Government's position of strict neutrality and made no effort to promote trade in articles that were contraband of war; this also served to reduce the number of trade opportunities that could with propriety be published. The number of proposals for Government supplies and construction increased to 1,167, as compared with 952 during the preceding year.

The conditions mentioned in the last annual report as being unfavorable to trade directory work continued during the year. The compilation and distribution of trade lists accompanying articles published in Commerce Reports was given very careful attention in lieu of the trade directory work, and there is an indication that American manufacturers are gradually turning to the sources of information in this country before writing to the consuls for names of dealers who may be in position to handle their goods.

Confidential circulars to the number of 57 were distributed. As pointed out in last year's annual report, the Bureau has adopted the policy of making the information heretofore sent out in confidential circulars available through the medium of the reserved information sheets connected with trade opportunities, and this has tended to decrease the number of confidential circulars.

The value of the trade press as a medium for bringing the work of the Bureau before the various industries and trades has long been recognized, but only during the past year have systematic efforts



been made to cooperate with the business editors in keeping the activities of the Bureau before the people most interested. The cooperation of the press is valuable in two ways: First, in arousing the interest of the different trades and in assisting to find suitable and competent men to conduct investigations; secondly, in keeping business men informed of the progress of investigations and the publications that have been issued.

#### DIVISION OF STATISTICS.

The abnormal conditions in our foreign trade created by the European war caused a large increase in the regular work of compiling figures for regular and special tables, as well as in the correspondence relating to statistical subjects, which is handled in the division of statistics. The number of statistical inquiries from business men actually engaged in foreign trade or contemplating entering the foreign field is constantly increasing.

Owing to the unprecedented increase in the volume of both imports and exports, the collectors of customs have not been able to render their monthly reports as promptly after the close of the month as during normal times, and the issues of the Monthly Summary of Foreign Commerce and other regular statistical publications have been considerably delayed, which has caused many complaints from persons who consult the figures regularly. Notwithstanding the several improvements instituted during the last two years in the methods of compiling the returns in the customhouses, as well as in this office, it does not appear probable that any considerable gain in timeliness in issuing the monthly publications will be possible while imports and exports continue at their present level. The only remedy would be a corresponding increase in the clerical staff engaged in compiling the figures at the customhouses and in this office.

The demand for more prompt publication of statistics has to some extent been met by preparing advance statements for special articles, showing in many cases more details by countries and customs districts than are usually published, which are distributed to interested parties. This service, however, must necessarily be restricted, as otherwise the work of preparing the regular tables would suffer and cause still more delay in the stated publications. The Statistical Office of the British Board of Trade furnishes specially prepared statements to interested parties under a system of charging fees for the actual services rendered and collects thousands of dollars annually for this service.

#### ENLARGED EXPORT CLASSIFICATION.

A new edition of Schedule B, governing the statistical classification of articles exported from the United States, was prepared, effective on and after July 1, 1917. The number of classifications was extended to 693, thus adding 98 new classes. The task of subdividing general classes with large transactions denominated as "all other," under chemicals, explosives, machinery, and manufactures of brass, cotton, india rubber, iron and steel, paper, silk, wool, and other groups was rendered difficult by the fact that, while many were

criticizing the large amounts shown under these somewhat meaningless headings, few were able to furnish any definite suggestions for breaking up the groups. With the assistance of collectors of customs and a few commercial organizations it was made possible to subdivide some of the larger "all other" classes, and the reports for next year will show considerable more detail. A plan is being considered to have the collectors of customs at the largest ports keep memoranda of the principal commodities included in the various "all other" classes for the information of this office at the time when the classification is being revised.

The list of countries in the table of domestic exports by articles and principal countries in the Monthly Summary of Foreign Commerce has been entirely reconstructed, and the number of countries shown greatly increased. As a general rule, the former practice of showing countries of destination for groups of classes, such as total agricultural implements, copper in pigs, rods, sheets and wire, total cotton cloths, fertilizers, boots and shoes, and other groups, has been changed so as to show countries for single important classes. This makes the table easier to compile, and at the same time furnishes more specific information to the trade. The principal countries in the monthly import table have also been revised and increased, although not so extensively as in the export statement, for the reason that the countries of origin of the principal articles imported do not change materially.

A new schedule governing the import classification has also been prepared, but has been suspended until certain changes to be made by the Treasury Department in the regulations and forms of import entries are put into effect.

#### PROGRESS IN MECHANICAL TABULATION.

The work of mechanical tabulation carried on by the division of customs statistics in the office of the collector of customs at New York was, on November 1, 1916, placed in charge of an official under the direct control of the Treasury Department. A constant improvement in the accuracy of the reports is noticeable as the employees engaged in the punching and tabulation of the cards and revising of the tabulated reports acquire experience and training in statistical work. It is owing to the lack of such training that it has not been possible so far to accomplish all of the results expected from the new method. While the process of punching the cards and arriving at the totals is more or less mechanical, persistent care in assembling the original data and a painstaking review of the totals in the monthly tabulated reports are indispensable in order to avoid errors. In some directions the tendency for errors is greater in the mechanical process than under the old methods, for instance, in crediting exports to the wrong district; on the other hand, many errors which were covered up under hand compilation are exposed and eliminated by mechanical tabulation.

So far the work has covered only exports, the import reports still being compiled by the collectors at the various ports and transmitted direct to this office. The plan to extend mechanical tabulation on July 1 of this year to the import, warehouse, noncontiguous, and other statistical reports was postponed on account of the large

amount of extra work caused by the preparation for war. The Treasury Department has in view a new form of entry blank and a plan of requiring an additional copy of each form of entry to be forwarded from all ports to the statistical office at New York, the required data to be punched from these direct to the cards, as is now done for exports. When this plan is put into effect separate documents for compiling import and export statistics will be available for the use of the statistical division, without having to call on collectors for the documents used in the collection of duties.

The new export regulations put into effect on February 1, 1916, have worked satisfactorily and few complaints were received during the last year. In order to establish uniform practices at the various ports and to explain doubtful points, several circular letters of instructions were sent out to collectors of customs. The advisability of legislation defining clearly the duties of shippers and carriers and establishing suitable penalties for failure to furnish the required particulars is recognized.

Under the provisions of section 336 of the Revised Statutes, the annual report on the Commerce and Navigation of the United States must be prepared for the fiscal year ending June 30. The business year in general use by commercial concerns in this country is, however, the calendar year, and many requests are received for statements showing trade by calendar year periods, which require considerable labor to compile. The Bureau of the Census, Geological Survey, Bureau of Mines, Interstate Commerce Commission, and other Government offices use the calendar year. The statistical reports of most European countries are also issued by calendar years, which makes attempts to compare their annual statistics of imports and exports with our records difficult if not impossible. The proposal to issue the annual report of Commerce and Navigation for the calendar instead of the fiscal year has been made by the committee on statistics of the Chamber of Commerce of the United States, also by the joint committee on statistics of the Departments of the Treasury and Commerce. The details necessary in preparing a bill authorizing this change will be submitted to the solicitor of the department in time to permit of its introduction during the next regular session of Congress.

#### INTERNAL COMMERCE STATISTICS.

Efforts to secure from Congress an appropriation for the purpose of restoring the service of collecting and publishing statistics of the internal commerce of the United States, discontinued in 1912 on account of the failure of an appropriation for this work, have so far been unsuccessful. Only two statements, movements of coal over 13 leading railroads, and shipments of commodities through the Sault Ste. Marie Canals, are being compiled and published. Reports on other subjects are still being received, although somewhat irregularly and in fragmentary form, from port authorities, transportation companies, and other concerns; they are filed for reference. Supplementary manifests of vessels engaged in traffic on the Great Lakes are placed at the disposal of the Bureau of the Census for use in compiling figures on water transportation.

The value of regularly recording and publishing information of domestic commercial movements on rivers, canals, and the Great Lakes, of coastwise commerce of the Atlantic and Gulf ports, and receipts and shipments of staple commodities at the principal distributing centers throughout the country is unquestioned, in the present emergency as well as in normal times. There is at present no private or official publication showing the movements of internal or domestic commerce collectively.

### ADMINISTRATION.

#### ACCOUNTS SECTION.

The work of the accounts section consists chiefly of verifying accounts presented for payment, maintaining a record of the funds disbursed from the various appropriations under the direction of the Bureau, preparing statements as to the costs of the various investigations, and instructing the field employees with regard to the method of rendering their accounts.

The placing of all agents traveling in the field on a per diem allowance in lieu of actual subsistence expenditures has, from the standpoint of convenience, worked out to be a very satisfactory arrangement. While the agents' expenses in most cases exceed \$4 per day (the maximum amount that is allowed by law), they are constrained to accept this amount rather than undertake the work of preparing detailed accounts. This is especially true of agents traveling in foreign countries, where local customs require payments to hotel servants to be made either weekly or monthly instead of by the day, thereby complicating their accounts, and where it is sometimes difficult to secure itemized receipts in support of charges for laundering and pressing. It is felt that a per diem allowance of \$5 would be more fair to the agent traveling in the United States, and in some foreign countries as much as \$7 is clearly necessary for the agent to cover bare subsistence expenditures. It is hoped that such an allowance will be authorized in our appropriations for the next fiscal year.

Arrangements have been made whereby the accounts section will handle the accounts of the trade commissioners engaged upon the lumber investigation, which is being carried on jointly by this Department and the National Lumber Manufacturers' Association, referred to in another part of this report.

There were passed for payment during the year approximately 1,825 vouchers covering salary and traveling expenses of employees in the field, purchase of supplies and equipment, and miscellaneous services (not including vouchers covering purchases made by the division of supplies out of the contingent appropriation), as against 1,876 vouchers during the year ended June 30, 1916, and 1,700 vouchers during the 1915 fiscal year. Approximately 4,600 letters were written during the current year as compared with 3,950 during 1916 and 3,700 during 1915. In addition there were issued 275 travel orders, as well as numerous statements showing the conditions of the various appropriations, expenditures made for the several investigations, and other fiscal matters. While there were several changes in the personnel of the accounts section during the year, there was no

permanent increase in the number of employees assigned to the section.

There was appropriated for the fiscal year 1917 the sum of \$100,000 for the commercial attaché service, \$125,000 for the promotion of commerce, \$100,000 for the promotion of commerce with South and Central America, and \$50,000 for investigating cost of production, in addition to the appropriation of \$130,640 for the salaries of statutory positions in the Bureau and an allotment of \$5,000 for contingent expenses, making a total of \$510,640 against a total of \$426,030 for the preceding year. Out of these appropriations there were employed in the field during the year 147 persons, including the commercial attachés, their clerks, and the employees in the district offices of the Bureau, a number of whom, however, were employed for only a short period. Forty-five of these employees disbursed funds as special disbursing agents, as against 28 special disbursing agents during the preceding year.

#### TRADE INFORMATION SECTION.

All requests by mail for miscellaneous commercial information are handled in the trade information section. Including the miscellaneous stenographic work done for other divisions of the Bureau, approximately 90,000 outgoing communications were prepared during the year.

Inquiries reaching this section cover a wide field, and requests for information upon various phases of export trade are handled daily. Requests for special data on specific problems are being constantly received from large and well-known firms already well established in foreign trade and having their own highly organized export departments, while many other inquiries are from firms and individuals who wish to enter the export field but are entirely unfamiliar with the technique of export trading or the sources of information readily available. Every effort is made to give these different inquiries special and individual attention.

The policy mentioned in a previous report of concentrating the stenographic force of the Bureau in this section was continued as far as practicable, and in addition to carrying on the regular work of the section, stenographers were also furnished to other offices of the Bureau. As a result of this arrangement, the section naturally bore a large share of the burden of emergency work in connection with the licensing of exports that devolved upon the Bureau during the closing weeks of the year. The necessity for much of this special work arose before the required additional personnel could be provided and was carried on in addition to the regular work with the regular stenographic and clerical force. Credit is due to the employees for the patriotic and uncomplaining spirit in which this emergency was met.

A definite plan was worked out and put into effect during the year whereby American export commission houses and other American export agencies may take advantage of the "Foreign trade opportunities" and confidential circulars issued by the Bureau. Up to this time no satisfactory plan had been agreed upon for making

this confidential information available to this particular class of firms, which are admittedly an important factor in our export machinery. These houses have been asked to fill out a special blank giving certain details about their organization and work, and a special card index has been compiled from the executed forms. To the names on this index are sent copies of all confidential circulars and the houses are also entitled to the addresses reserved from any "Foreign trade opportunity" notices which they may request from time to time.

Effective April 19, 1917, the trade-information indexes and files of what had been known as the "miscellaneous section" were placed under the supervision of the trade information section. This change added two regular employees to the section.

#### DISTRIBUTION SECTION.

The distribution section is charged with the distribution of the various monographs, confidential circulars, press statements, and other literature published by the Bureau.

Approximately 1,500 new firms were added to the Exporters Index during the year, which now comprises 25,000 names. This is a list of American concerns known to be interested in foreign trade. Confidential circulars, notices concerning the issuance and nature of new publications, and other commercial information given out by the Bureau are sent to firms specifically interested. Approximately 112,000 copies of confidential and miscellaneous circulars and 433,000 "selling" letters were sent out from this list during the year, the latter proving an important factor in increasing the sale of the Bureau's publications. The distribution section also maintains various other lists in addition to the Exporters Index, such as commercial organizations, trade associations, trade journals, banks with foreign departments, steamship companies, export commission houses, and foreign freight agencies and forwarders, to which are sent printed matter in regard to foreign trade possibilities, notices of new publications of the Bureau, and other matter of specific interest.

Copies of Commerce Reports containing subjects of specific interest to firms registered on the Bureau's list are marked and sent to those firms. Letters of appreciation from the recipients of this service demonstrate its value to manufacturers and exporters and the desirability of its continuance. Approximately 25,000 marked copies were mailed out during the year.

There was a large increase during the year in the lists of foreign importers forwarded by consular officers and the Bureau's special representatives, 800 new lists being added to the already large collection. Some 3,000 individual requests were received for these lists during the year. They are mimeographed and each district and co-operative office receives a supply for distribution to local inquirers. They are referred to in Commerce Reports and indicated by a file or reference number.

The following table shows the number of publications and circulars distributed by the Bureau during the fiscal year 1915, 1916, and 1917:

## PUBLICATIONS DISTRIBUTED DURING THE FISCAL YEARS ENDED JUNE 30, 1915, 1916, AND 1917.

Publications.	1915	1916	1917
<b>Monographs:</b>			
Special agents series.....	12	23	22
Special consular reports.....	6	4	1
Miscellaneous series.....	10	15	16
Foreign tariff series.....	3	4	3
Foreign tariff notes.....	3	4	4
Confidential bulletins.....	5	1	1
Statistical publications.....	57	56	55
Confidential circulars.....	501	178	51
Press letters.....	39	263	95
Selling letters.....	37	37	45
Miscellaneous circulars.....	25	20	11
Annual report of Chief of Bureau.....	1	1	1

## APPROPRIATIONS AND ESTIMATES.

The table below shows the appropriations that have been available for the work of the Bureau during the last two fiscal years and the estimates that are to be submitted for the year ending June 30, 1919. It gives the number of persons employed and the amount of money expended in each branch of the work. It will be seen that an appropriation of \$698,320 is asked for the fiscal year 1919, this being an increase of \$219,200 over the year 1918.

## APPROPRIATIONS FOR THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE DURING THE FISCAL YEARS ENDED JUNE 30, 1917 AND 1918, AND ESTIMATES FOR THE FISCAL YEAR ENDING JUNE 30, 1919.

Appropriations and classes of work.	1917		1918		1919	
	Employ-ees.	Amount.	Employ-ees.	Amount.	Employ-ees.	Amount.
<b>Statutory appropriation:</b>						
Administration.....	5	\$16,350	5	\$16,350	5	\$16,350
Accounts, records, and files.....	19	18,540	27	28,980	30	34,080
Collating tariffs.....	3	4,600	3	4,200	5	7,700
Compiling statistics.....	29	40,750	30	41,290	32	44,790
Distributing information.....	5	5,000	5	5,100	6	6,900
Division of commercial attachés.....	2	3,000	2	2,200	(a)	(a)
Division of district offices.....	1	1,000	2	3,200	(a)	(a)
Division of field investigators.....			2	2,800	(a)	(a)
Editorial work.....	14	20,100	15	21,800	16	25,800
Latin-American division.....			3	4,400		
Research and translation.....	4	7,000	5	8,600	6	9,800
Trade information.....	13	14,300	14	15,200	17	19,900
<b>Total.....</b>	<b>95</b>	<b>130,640</b>	<b>113</b>	<b>154,120</b>	<b>117</b>	<b>168,320</b>
<b>Promoting commerce:</b>						
Office staff.....	2	3,600	(b)	(b)	10	14,000
Field investigators.....	c 19	68,400	c 25	75,000	12	65,000
Miscellaneous.....		3,000		5,000		8,800
Maintenance of district offices—Commercial agent at large.....					1	2,800
Salaries in district offices—						
Boston.....	3	5,100	3	4,300	3	4,300
Chicago.....	3	4,000	3	4,550	3	4,550
New Orleans.....	2	3,000	2	2,800	2	3,000
New York.....	14	16,800	10	12,800	10	12,800
Division commercial agents.....	4	7,100	3	4,400		
San Francisco.....	2	3,100	2	3,100	2	3,100
Seattle.....	2	3,000	2	3,000	2	3,000
St. Louis.....	2	3,100	2	3,000	2	3,000
Miscellaneous, including rent, traveling expenses, supplies, cablegrams, temporary clerical assistance, etc.....		4,800		6,050		10,250
<b>Total.....</b>	<b>53</b>	<b>125,000</b>	<b>52</b>	<b>125,000</b>	<b>47</b>	<b>135,000</b>

a These positions provided for under lump-sum appropriations.

b These positions provided for under statutory appropriation.

c Including employees serving less than a year and those on nominal salaries.

## APPROPRIATIONS FOR THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE DURING THE FISCAL YEARS ENDED JUNE 30, 1917 AND 1918, AND ESTIMATES FOR THE FISCAL YEAR ENDING JUNE 30, 1919—Continued.

Appropriations and classes of work.	1917		1918		1919	
	Employ- ees.	Amount.	Employ- ees.	Amount.	Employ- ees.	Amount.
<b>Commercial attachés:</b>						
Office staff.....					5	\$6,800
Salaries, commercial attachés, clerks, and expenses—						
France (Paris).....		\$10,000	2	\$10,000	2	10,000
Germany (Netherlands).....	2	10,000	2	10,000	2	10,000
Italy.....					2	10,000
Mexico.....					2	10,000
Russia (Petrograd).....	2	10,000	2	10,000	2	10,000
Spain.....					2	10,000
United Kingdom (London).....	2	10,000	2	10,000	2	10,000
Central America.....					2	10,000
Argentina (Buenos Aires).....	2	10,000	2	10,000	2	10,000
Brazil (Rio de Janeiro).....	2	10,000	2	10,000	2	10,000
Chile (Santiago).....	2	10,000				
Peru (Lima).....	2	10,000	2	10,000	2	10,000
Venezuela, Colombia, and the West Indies.....					2	10,000
China (Peking).....	2	10,000	2	10,000	2	10,000
India.....					2	10,000
Japan (Tokyo).....			2	10,000	2	10,000
Australia (Melbourne).....	2	10,000	2	10,000	2	10,000
South Africa.....					2	10,000
Miscellaneous, including contin- gent expenses.....						23,300
<b>Total.....</b>	<b>20</b>	<b>100,000</b>	<b>20</b>	<b>100,000</b>	<b>39</b>	<b>200,000</b>
<b>Cost of production:</b>						
Office staff.....	11	12,720				
Field investigators.....	11	35,000				
Miscellaneous, including supplies.....		2,280				
<b>Total.....</b>	<b>22</b>	<b>50,000</b>				
<b>Latin America:</b>						
Office staff.....	16	20,700	18	26,700	17	26,000
Field investigators.....	* 16	75,000	* 14	65,000	11	65,000
Miscellaneous.....		4,300		8,300		10,000
<b>Total.....</b>	<b>32</b>	<b>100,000</b>	<b>32</b>	<b>100,000</b>	<b>28</b>	<b>100,000</b>
<b>Far East:</b>						
Office staff.....					13	20,500
Field investigators.....					15	74,500
Miscellaneous.....						5,000
<b>Total.....</b>					<b>28</b>	<b>100,000</b>
<b>Grand total.....</b>	<b>222</b>	<b>505,640</b>	<b>217</b>	<b>479,120</b>	<b>259</b>	<b>608,320</b>

\* Including employees serving less than a year and those on nominal salaries.

The following table gives the number of employees in the Bureau of Foreign and Domestic Commerce during the years 1912 to 1918. It shows that in the fiscal year that has just closed the number of lump-sum employees was 127 and those holding statutory positions 95, while during the year 1918 the force paid from special appropriations will probably reach but 104 persons, with 113 statutory employees.



**EMPLOYEES OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE DURING THE FISCAL YEARS 1912 TO 1918.**

Year ended June 30—	Employees under lump-sum appropriations.								Regular statutory force of Bureau.	
	Promoting commerce.		Promoting commerce with South and Central America. <sup>a</sup>		Investigating cost of production. <sup>a</sup>		Commercial attachés.		Total lump-sum employees.	
	Em- ployees.	Appro- priation.	Em- ployees.	Appro- priation.	Em- ployees.	Appro- priation.	Em- ployees.	Appro- priation.		Em- ployees.
1912.....	11	\$60,000	—	—	—	—	—	—	11	92
1913.....	12	60,000	—	—	—	—	—	—	12	88
1914.....	16	60,000	—	—	13	\$50,000	—	—	29	88
1915.....	34	75,000	17	\$50,000	18	50,000	20	\$100,000	89	89
1916.....	32	77,000	35	75,000	18	50,000	20	100,000	105	86
1917.....	53	125,000	32	100,000	22	50,000	20	100,000	127	96
1918.....	52	125,000	32	100,000	—	—	20	100,000	104	113

<sup>a</sup> Exclusive of temporary employees.

<sup>b</sup> Including 8 employees paid out of tariff appropriation; later transferred to statutory positions.

<sup>c</sup> Including tariff appropriation (\$10,000).

<sup>d</sup> Includes 2 positions in the bureau provided for by appropriation act.

<sup>e</sup> In part estimated.

**PRESENT NEEDS OF THE BUREAU.**

The Bureau has suffered during the past year because of the inadequacy of salaries paid for administrative positions. In the Bureau appropriation for salaries there is still only one chief of division allowance as high as \$2,500. At least a \$2,500 position should be available for chiefs of the following divisions: Division of statistics, the division of foreign tariffs, and the editorial division. At present, in addition to the one \$2,500 chief of division position, which I have mentioned, the only other specific administrative positions authorized are one chief of division at \$2,000, one assistant chief of division at \$2,250, an editorial assistant at \$2,000, a translator at \$2,000, and an expert in commerce and finance at \$2,000. This salary scale is not on a par with the salaries now being paid in other Government offices in Washington. The work is important and requires good men. Even in this time when economy is the watchword I again want to point out the need of providing statutory places for the divisions above mentioned and two other statutory places at \$2,100 for the research division and the accounts section. Authorization should also be made in the lump-sum appropriations for promoting commerce, commercial attachés, and the Far Eastern work, for expenditures for personal services in Washington, in order to enable the employment and retention of competent administrative employees and experts.

In the appropriation for the commercial attaché service authorization should be contained for expenditures for personal services in foreign countries sufficient to allow adequate compensation for clerks and to make possible the employment of janitors and other necessary

assistants. Unfavorable foreign exchange rates and great increases in the cost of living make necessary some provision for increased compensation or a system of post allowances for our foreign representatives. Authorization by law is needed to increase the subsistence allowance of representatives traveling either in the United States or in foreign countries.

#### TRANSFER OF EXPORT-LICENSE WORK.

Since the body of this report was composed there has been a transfer of the administrative duties connected with export licenses under the espionage act from the Bureau of Foreign and Domestic Commerce to a war-time organization known as the War Trade Board. To this board the Bureau will contribute freely of its men, time, and money for the successful operation of the act in question. An effort will be made to modify for the benefit of American commerce any administrative rulings which may in actual operation prove too severe on commerce, with due regard to the belligerent objects sought. Our good offices will naturally be exercised through the Department of Commerce representative on the War Trade Board, who is expected to reflect the views of American business as shared by the Department in its position of guardian to our commercial welfare.

#### CONCLUSION.

In closing this report let me emphasize the splendid spirit that is actuating the employees of the Bureau of Foreign and Domestic Commerce. It should be recognized that the character of the men and women employed stands high in points of intelligence and education. Both at home and abroad the Bureau employees have had to face increased work, and our representatives in foreign countries especially have had distracting difficulties to meet on account of the war. With a spirit of patriotism and loyalty to their work they have performed their tasks without complaint. A very considerable strain was placed on the main office in Washington during the last year, after the United States entered the war, and many extra hours of work were performed as a matter of course, not only minus complaint but with real enthusiasm.

Sir, I congratulate you on the quality of the force which in the Bureau of Foreign and Domestic Commerce composes part of your official family.

Respectfully,

BURWELL S. CUTLER,  
*Chief of Bureau.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*



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**REPORT**  
**OF THE**  
**DIRECTOR OF THE BUREAU OF STANDARDS**

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**361**





# **NATIONAL BUREAU OF STANDARDS**

**Washington, D. C.**

**1917**

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## **FUNCTIONS**

**Development, construction, custody, and maintenance  
of reference and working**

**STANDARDS - - - - -**

**and their intercomparison, improvement, and application  
in science, engineering, industry, and commerce.**

# REPORT OF THE DIRECTOR, BUREAU OF STANDARDS.

DEPARTMENT OF COMMERCE,  
BUREAU OF STANDARDS,  
*Washington, July 1, 1917.*

SIR: There is submitted herewith a report of the work of the Bureau of Standards for the fiscal year ended June 30, 1917.

## I. FUNCTIONS, ORGANIZATION, AND LOCATION.

Before describing in detail the various scientific and technical problems in which the Bureau of Standards is engaged, the following brief statement as to its functions and organization may be helpful to those unfamiliar with the subject of standardization in the broad and modern sense.

The standards with which the Bureau is authorized to deal may be conveniently classed as follows: Standards of measurement, standard values of constants, standards of quality, standards of mechanical performance, and standards of practice.

### 1. STANDARDS OF MEASUREMENT.

A standard of length may be taken as an example of a standard of measurement. It must be a length which is unchanging, reproducible, and capable of being compared with the working standards used in the most precise scientific work or with those used in commerce and industry. The fundamental standard must be subdivided and working standards prepared of these parts, and for the measurement of greater lengths standards must be prepared which are multiples of the fundamental standard. This process of subdividing and multiplying the standard involves difficulties as great as those met with in the preparation of the fundamental standard itself.

The construction of a set of standard weights from a single unit is also an illustration; a whole set of standard weights must be prepared before the standard weight of the Government can become available to the public. When the standard of length or weight has been found with as many desirable qualities as possible, and before the working standards of the subdivisions or multiples can be prepared, the question as to the method of comparison arises, which again involves the solution of difficult scientific problems in connection with the balance or the methods used. These balances range from that capable of measuring the thousandth part of a milligram



to the large testing machine capable of measuring a load of thousands of tons. The complete range must be covered, which involves not only a large number of working standards, all of which must agree with the fundamental standard, but apparatus suitable for the comparison of these standards with all of the lengths or weights found in practice.

These steps and equipment are absolutely essential in order to secure uniform measurements of length or weight throughout the country, and they have their counterpart in every quantity that has to be measured, whether it be length, weight, temperature, heat, light, or the various electrical measurements or other standards of measurement. These standards in one form or another are involved in practically every scientific investigation, industrial process, engineering structure, or commercial transaction.

### 2. PHYSICAL CONSTANTS.

There are many fixed relations between physical quantities, the values of which it is extremely important to know. These values are usually termed "physical constants," and are used in every branch of scientific work or industry. The amount of heat required to change a pound of water into steam under normal conditions and the relation between heat and mechanical energy are two important physical constants; their values are used in practically every computation in connection with the designing of steam engines and boilers, the tests of their efficiencies, or the measurement of their output. The amount of heat required to turn liquid ammonia into vapor or the amount of heat required to melt a pound of ice are constants equally important in the refrigerating industries. The value of the relation between electrical and mechanical energy is involved in many important commercial transactions concerned in electricity.

Accurate and authoritative values of these constants are just as essential as in the case of standards of measurement. Many of these now in use are old and obsolete and need redetermination by means of the best modern facilities for physical measurement. Their determination involves the most difficult and precise work in all branches of physics and chemistry—a fact not generally known by those not engaged in the scientific or technical work where these constants are used.

### 3. STANDARDS OF QUALITY.

A standard of quality for a given material may sometimes take the form of a sample of that material with which other materials of the same kind can be compared, but this is generally a makeshift of the poorest sort. It is only resorted to in the absence of definite and reliable specifications in terms of measurable properties; that is to say, a standard of quality of a material usually takes the form of a specification or definition of its properties, involving, of course, the measurement of those properties by means of the usual standards of measurement. A certain kind of steel, a cement, a paint, an oil, or a paper or cloth is found by use to be good or poor. The questions then arise, Why is it good or poor; What are the physical or chemical properties or the particular combination of elements which make

it of good or poor quality; How are its properties to be measured or its constituents determined? These are questions for the laboratory to answer and involve physical and chemical investigations of the most difficult sort.

A standard of quality for a given material necessarily takes into account the purpose for which the material is to be used; to set the standard too low results in losses, poor efficiency, and even loss of life; to make it too high may result precisely in the same thing; that is to say, the material must be suitable for the purpose intended, and the Bureau's investigations in connection with the properties of materials are to enable the user of these materials, first, to select intelligently the material best suited for the purpose; second, to specify it in terms which the producer can not mistake; and, third, to make the necessary tests to ascertain whether or not the material supplied is in accordance with the specifications.

The actual testing of materials by the Bureau of Standards to ascertain whether or not they comply with specifications is confined almost exclusively to Government purchases, but in making these tests (in which the Bureau has had the hearty cooperation of practically all the departments of the Government service) it is compelled to make many investigations concerning the properties of materials, their specification and measurement. While this work is of great value in placing Government purchases on a correct business basis, the results of the investigations as to the properties of materials and the information gained in testing Government supplies are even more important to the general public and are distributed in the form of suitable publications.

The Bureau does not compete with private testing laboratories, but endeavors to assist them by the development of standard specifications, methods of measurement, and other matters where uniformity is desirable, much of which information, as stated above, is secured in connection with the testing of materials purchased by the Government and a close observation of their use.

The time is not far distant when it will be required that all materials bought or sold shall be as represented, but it should be kept in mind that this is impossible except in the case of those materials where proper standards of quality and methods of measurement have been developed. It must not be assumed that the purchaser or user is the party principally benefited in the development of such standards; on the contrary, the manufacturer, first of all, is interested in the quality of all things which affect the quality of his product, and while the Bureau's efforts in this field are devoted principally to the pointing out and measurement of those properties upon which the quality of the materials depends, it is to be regretted that its force and equipment are insufficient to render more assistance to manufacturers with a view to a direct improvement of those parts of the process upon which the quality of the output depends.

#### 4. STANDARDS OF PERFORMANCE.

The value of an instrument, device, or machine almost always depends upon the efficiency of its performance. In such cases it is necessary to state the performance desired or guaranteed in terms which are correct and susceptible of measurement. As in the case

of standards of quality, the standard involved is more often in the form of a specification, but specifications are useless unless based upon correct scientific and mechanical principles and supplemented with a statement of the method to be used in ascertaining whether or not the specifications or guaranties have been complied with.

The performance of an engine or boiler, a pump, an electrical generator or motor, a weighing device, or a telescope can usually be measured, but the quantities to be measured and the method used must be specified correctly and understood by all the parties concerned in the construction, purchase, or use of such apparatus. To do this properly involves the use of standards of measurement, standard values of constants, and standards of quality. The Bureau of Standards does not attempt to cover this field completely, but only those cases where there is a lack of definite information upon which to base specifications and only to the more important classes of apparatus. To secure this information involves investigations quite as scientific in character and as difficult as in the case of other standards, as well as a knowledge of technical and manufacturing processes.

The Bureau's activities in this field have only been developed to a slight extent and almost entirely in connection with Government purchases. It has had in this, as well as in the field of the properties of materials, the most hearty cooperation of the various Government experts, manufacturers, engineers, and technical societies.

#### 5. STANDARDS OF PRACTICE.

Standards of practice are generally involved in the enactment of laws when technical and scientific matters are concerned, in the ordinances relating to the regulation of public utilities, and in the establishment of building and safety codes. Like standards of performance, they are dependent upon standards of measurement and standards of quality and are of the most vital importance in questions pertaining to the welfare and safety of the public. In a field so broad the Bureau can touch only upon the more important aspects of the work, where national uniformity is desired—fields which can not be covered efficiently in private laboratories.

#### 6. RELATION OF THE BUREAU'S WORK TO THE PUBLIC.

It is perfectly obvious, even to one unfamiliar with the subject, that the maintenance on the part of the Government of correct standards of measurement or quality or performance calls for continuous scientific and technical investigations of the highest grade, involving the most competent expert services and the best scientific equipment. When this is accomplished, there still remains the serious problem of making the results available and useful to the public.

The Bureau compares with its own standards of measurement the standards or measuring instruments of States, cities, scientific laboratories, educational institutions, manufacturers, Government bureaus, or the public, for which a nominal fee is charged, except in the case of the National and State Government institutions. It gives advice concerning these standards or their use, whether it be in connection with the enactment of laws, regulations, or ordinances concerning the weights and measures of everyday trade or in con-

nection with precision standards used in scientific work and the industries. It gives advice upon request to State and city officials, public-service commissions, and public-utility corporations regarding the standards of measurement, or quality, or performance involved in legislation or regulation pertaining to the public utilities. Many questions of disagreement between the public and utility companies as to these matters are referred to the Bureau for advice or adjustment, often avoiding unfair or inconsistent regulations, as well as long-drawn-out and expensive litigation. There is a great need on the part of the public for unbiased and reliable information pertaining to the standards entering into the regulation and sale of the services of public utilities. As far as possible such information is given in the form of publications upon definite subjects.

It must not be inferred from the above that the Bureau's activities are devoted principally to the interests of the user or consumer. The fundamental facts regarding standards of measurement, quality, or performance are the very things which most deeply concern manufacturers; they are fundamentally concerned, either directly or indirectly, with the improvement of methods of production or the quality of the output. It may be said that the Bureau occupies somewhat the same position with respect to the manufacturing interests of this country that the bureaus of the Department of Agriculture do to the agricultural interests. Many industries are just beginning to realize the importance of precise methods of measurement and scientific investigation, which, in practically every case, involve some kind of measurement.

It is upon quality as well as upon price that competition must finally depend, whether in domestic or foreign commerce. The use of exact methods and scientific results is the greatest factor in the improvement of quality, efficiency, or the development of new industries. The educational value of the Bureau's work in this respect is almost entirely unknown to the general public, and yet the Bureau receives hundreds of letters, as well as many personal visits from manufacturers, seeking information as to standards of measurement, how to use them, how to measure the properties of materials, or as to the fundamental physical and chemical principles involved; also, what is of even greater importance, how to initiate and carry out scientific investigations and tests on their own account in their particular fields of work.

The importance of maintaining scientific institutions having to do with standardization and the application of precise measurements to the industries has been recognized by all the leading countries of the world. Great Britain maintains the Standards Department of the Board of Trade, which is in charge of the standards and inspection service of the trade weights and measures; also the National Physical Laboratory, whose functions include matters pertaining to scientific and technical standards, physical constants, and to some extent the properties of materials. The Laboratoire d'Essais, of France, while not as extensive as the English institution, is charged with similar duties. Germany maintains three such institutions—the Normal-Eichungs Kommission, equipped with the buildings, personnel, and apparatus necessary in standardizing and controlling the weights and measures of trade; the Physikalisch-Technische Reichsanstalt, covering testing and investigations in connection with

scientific and technical standards other than weights and measures; and the Prussian Government maintains the *Materialprüfungsamt*, a large institution devoted to the investigating and testing of structural, engineering, and other materials.

It is generally recognized that these institutions have been exceedingly important factors in the industrial progress of these countries.

#### 7. RELATION OF THE BUREAU'S WORK TO THE GOVERNMENT SERVICE.

The bureaus of the Government engaged in scientific and technical work are necessarily dependent upon standards of measurement of every variety. In addition, many of them are engaged in the design, construction, and specification of a great variety of special apparatus, in which the principles of mechanics, heat, optics, electricity, and chemistry are involved and are vital to their efficiency and successful operation. In such matters the Bureau has been consulted most freely by the War and Navy Departments, the Post Office Department, the Department of Agriculture, the Public Health Service, and others.

The engineering and building construction in progress at all times by the Government is exceedingly great, both in variety and magnitude; in all of it a knowledge of the materials employed is of fundamental importance from the standpoints of economy, efficiency, and safety. The work of testing and investigating the properties of structural materials was taken up and is carried on primarily for the purpose of securing the information needed by the Government service in its structural work. This information is as necessary to the public in construction work, and every effort is made by the Bureau to make its findings in a form available to the public generally. The demands for information of this sort have come from practically all Government bureaus and establishments, but especially so in connection with the structural work carried on by the Office of the Supervising Architect, the engineering branches of the Army, the Bureau of Construction and Repair of the Navy, the Panama Canal, and the Reclamation Service.

The Bureau of Standards serves as a testing bureau for the various departments of the Government when called upon, and as such is assisting to place Government purchases upon an economical and businesslike basis. The example of the Government in such matters has a far greater influence upon the public than is generally supposed. The Government can do no greater service to the country than to place its own purchases upon a basis which may be taken as a standard by the public at large. This work involves the specification of a wide range of structural and miscellaneous materials and their testing, when delivered, to ascertain whether or not they comply with the specifications. This is especially important, since such materials are purchased by means of competitive bids, a method resulting in much fraud and injustice unless suitable standards are established and successful bidders held absolutely to this standard in making deliveries. Furthermore, most purchasing officers are realizing the great importance of having such testing done by a disinterested institution equipped with the scientific and other facilities for performing the service in a manner that is fair to both parties concerned in the purchases.

Among the many Government bureaus and establishments which have utilized the Bureau of Standards as a testing institution in connection with the purchase of supplies may be mentioned the Government Printing Office, in connection with the purchase of paper, inks, and printing supplies; and the Post Office Department, in connection with the purchase of paper, twine, textiles, etc. A wide range of materials has been tested for the Quartermaster's Department of the Army, the Paymaster's Department of the Navy, and the Panama Canal. The General Supply Committee has called upon the Bureau for assistance in the specification of all sorts of supplies and equipment, as well as the testing of samples submitted by bidders of the supplies bid upon. Practically every branch of the Government service, including the District of Columbia, utilizes the Bureau of Standards as a testing bureau. Here again, as in other fields of the Bureau's activities, it gains much useful knowledge which is given to the public in the form of suitable publications.

Many bureaus of the Government service are charged with the administration of laws and the establishment of regulations in which scientific data are vital. This is true to a much greater extent than is generally supposed. The Bureau of Standards has cooperated freely with such branches of the Government and the service rendered has involved every department of physics and chemistry covered by the Bureau's activities. The neglect of such matters in the past has been a frequent source of misunderstanding and litigation between the Government service and the public. Conspicuous examples of bureaus to which such assistance has been given are the Customs and Internal Revenue Services; the Steamboat-Inspection and Coast Guard Services, in the promulgation of safety regulations; and the Bureau of Navigation of the Department of Commerce, in the administration of laws regulating the use and inspection of radiotelegraphy.

#### 8. ORGANIZATION.

The organization of the Bureau's scientific and technical staff is based upon the nature of the expert service involved rather than upon the classes of standards. For example, the division of weights and measures has to do with all matters pertaining to standards of length, mass (weight, as it is commonly termed), time, density, and similar questions, whether they arise in connection with the precision standards used in scientific investigation, the master standards of manufacturers, or the ordinary weights and measures of trade. A standard of quality or performance where any of the above measurements form the fundamental and most important factor would be referred to this division.

The division of heat and thermometry has to do with heat standards, the testing of heat-measuring apparatus, the determination of heat constants, of which there are many, and all investigations pertaining to quality or performance where heat measurement is the essential and predominating factor.

Similarly, the electrical division is concerned with all the electrical problems that may be taken up at the Bureau, whether in connection with the various electrical standards of measurement, electrical constants, the electrical properties of materials, or the performance of electrical equipment.

Questions in optics enter into standards of all kinds to a greater extent than has been supposed; hence, there is an optical division provided, with experts in spectroscopy, polarimetry (used in sugar analysis), color measurement, the principles of optical instruments, and the measurement of the optical properties of materials.

Practically all investigations concerning the various classes of standards involve chemistry in one form or another. There are also many chemical standards and questions which arise in connection with chemical work generally, especially in the industries; hence, there is a chemical division, cooperating with every other division of the Bureau, as well as taking care of the questions of a purely chemical nature that come to the Bureau and which fall within its functions.

In the case of the more important technical fields, divisions have been formed dealing more specifically with large and important classes of materials, but many of the purely scientific questions involved would be handled by one of the above-mentioned scientific divisions or jointly with it. The work of the technical divisions is just as scientific in character, but deals more specifically with manufactured products.

The work of the structural engineering and miscellaneous materials division includes the investigation, testing, and preparation of specifications for these materials, such as the metals and their alloys, stone, cement, concrete, lime, the clay products, paints, oils, paper, textiles, rubber, and other miscellaneous materials.

The division of engineering research makes investigations and tests regarding the performance and efficiency of such instruments, devices, or machinery as the Bureau may take up that do not fall directly under one of the scientific divisions. The division is a small one and its work is devoted almost exclusively to assistance given other departments of the Government and the General Supply Committee in designing, specifying, or testing equipment. It should in time form one of the more important branches of the Bureau's work.

The questions pertaining to the manufacture, specifications, testing, and use of the metals and their alloys have become so important that a division known as the metallurgical division has been formed of the experts engaged in these problems.

The employees engaged in clerical work, purchasing, files, records, accounting, and library are known as the office division, while those employed in the operation of the mechanical plant, the various shops, and the care of the buildings and grounds form the engineering and construction division.

#### 9. LOCATION.

The laboratories of the Bureau of Standards are located in the northwest section of Washington, on Pierce Mill Road, near Connecticut Avenue, and are reached by the Chevy Chase car line. They were located outside of the business center of Washington in order to insure freedom from mechanical, electrical, and other disturbances common to the business and more thickly populated sections of the city. Furthermore, the area of ground necessary precluded a site near the city. It has been found by experience that the efficiency of the employees, especially those engaged in testing and scientific investigation, has been greatly increased by the location of the laboratories in a section free from the ordinary disturbances of city life.

## II. SCIENTIFIC AND TECHNICAL DIVISIONS.

### 1. WEIGHTS AND MEASURES.

[Length, area, volume, mass, density, pressure, and time, including researches on units and standards, measuring methods and instruments, specifications and tolerances, and the standardization incident thereto for inspectors of weights and measures, manufacturers of measuring appliances, scientific and technical laboratories, Government bureaus, engineers, and the general public.]

#### Length Measures.

About 1,035 articles were measured for length during the year, of which 731 were polariscope tubes and 156 were tapes of steel, invar, or linen. The remainder included 65 gauges and calipers, an increased number over last year, 7 line standards, 2 level rods, 58 sieves and samples of sieve cloth, and 16 miscellaneous pieces of apparatus.

#### Linear Expansion of Materials.

During the year there were made 107 expansivity tests, 77 of which were incident to research work carried on by the Bureau; the remaining tests were made on specimens submitted by the Federal Government and from outside sources.

In connection with the research work on the linear expansion of materials, 12 specimens of bronze, 6 of the alpha and 6 of the beta phase, were thoroughly studied, involving temperature ranges extending from 20° C. to 600° C. This work was carried out as an investigation of a theory that the differential expansion between the alpha and beta particles, ordinarily evenly distributed in bronze, is sufficient to cause the ruptures so commonly met in this class of material. The results of this study indicate that the difference in the expansion of the two phases is sufficient to cause these ruptures. Many interesting details were observed in connection with this investigation. Specimens of the alpha phase are regular in their expansion and after being heated return to their original length, whereas specimens of the beta phase exhibit peculiarities which are quite constant and they fail to return to their original length after being heated to 300° C. or above.

Research work on rolled brass was carried out as part of a study for the determination of the effect of the direction of rolling on the properties of brass. Twenty-nine samples of varying thickness were tested, a part of which were measured parallel and a part perpendicular to the direction of rolling. The expansion varied somewhat with the thickness of the material and a permanent set resulted after the samples were heated to 300° C., which amounted to as much as 0.4 millimeters per meter for the thin samples. This permanent set was either an increase or decrease in the length of the specimen according to whether it had been cut longitudinally or transversely with the direction of rolling.



A preliminary test has been made of six representative specimens of 109 samples of copper alloy submitted by a large commercial company in order to determine the probable behavior of these samples. Research work is being undertaken in connection with these samples for the purpose of determining the expansivity properties of the alloy from which they are made, and the results so far indicate that the expansivity of this material is a regular function of its composition; in fact, both the first and second terms of a quadratic equation representing the expansion of each alloy vary regularly with the composition.

The unusual behavior of marble under heat treatment seems to have received little, if any, consideration by those interested in this material. A study of marble subjected to heat treatment reveals the fact that the coefficient of expansion increases from about 0 at 0° C. to  $28 \times 10^{-6}$  at 300° C. Moreover, after the marble has been expanded by heat, it does not return to its original dimensions, but a permanent increase results, the magnitude of which depends upon the temperature to which the specimen has been heated. A permanent increase in length amounting to as much as 4 millimeters per meter has resulted from heating a specimen to 300° C. This work has a very important bearing on some of the marble industries, and is especially important in connection with the manufacture of electrical standards where coils are wound on marble bases.

The results obtained from investigations on nickel steel, begun during the fiscal year 1916, were checked up and data were found to be in close agreement, both with the Bureau's previous results and with those obtained by Guillaume, wherever it was possible to draw a comparison. This research has been completed and the results are now in course of preparation for publication.

It recently became desirable to make expansion tests to as high as 1,000° C. A new furnace has therefore been designed for this purpose, the special features of which consist of methods of making and mounting the resistor so that it is readily accessible and easily replaced in case of an interval break in the electric circuit.

### **Standard Screen Scale.**

The standard screen scale for testing sieves, adopted by a conference of representatives of various technical societies, Government bureaus, and private firms interested in sieving tests of materials, has been issued by the Bureau, together with specifications and tolerances under which the Bureau will test and certify sieves of this series. This screen scale has a wide range of openings, from 8 to 0.044 millimeter (0.315 to 0.0017 inch), and is intended to cover practically all materials upon which fineness tests are made. Its adoption will unify the results of sieve tests and will reduce the varieties of sieves required for such work.

### **Gauge Work.**

As soon as it became evident that the United States would be compelled to expand its military activities, the Bureau profiting by the experience of the national testing laboratories of Europe, began to make preparation for the certification of gauges used in the manufacture of munitions. Representatives from the Bureau visited a

number of the munitions plants in the country, and the methods of gauging employed in these plants were carefully studied. A representative was also sent to Canada for the purpose of studying the operations of the gauge department of the Ministry of Munitions, a department organized entirely since the beginning of the war.

The Bureau then submitted an estimate for an appropriation to cover this work, to be immediately available, and the proposed appropriation was made a part of the act making appropriations to supply urgent deficiencies in appropriations for the Military and Naval Establishments, which was approved June 15. The Bureau immediately ordered some of the more important pieces of apparatus that would be required in the work and in the securing of which the element of time was of great importance.

A temporary building, constructed some years ago in connection with experiments on the use of various kinds of cement and lime coverings for outside walls and which had never been finished inside, was assigned to the gauge work, and immediate steps were taken to prepare it for occupancy. This building was almost ready to occupy by the end of the fiscal year, and a large amount of apparatus and the force needed to carry on this work had been secured.

#### **Optical Protractor.**

In preparing for the testing of munition gauges in large quantities, it became necessary for the Bureau to design a number of special instruments in order to carry on this work. Notable among these is the optical protractor. This instrument consists of a microscope containing a knife-edge in the ocular plane which can be turned about an axis practically coincident with the optical axis of the microscope. In use the knife-edge is made coincident with the other side of the thread and a second reading on the circle taken, the difference between the two readings giving the thread angle. The principal advantage of this protractor over previous designs is in the increased accuracy with which settings can be made. It is possible to set the knife-edge parallel with the general direction of the sides of the screw thread being measured within three minutes of arc under good optical conditions.

#### **Leather Measuring Machines.**

At the request of various associations of tanners and shoe manufacturers, the Bureau undertook an investigation of the machines and methods used in the leather trade for the measurement of the area of hides and skins, the major portion of shoe leather other than that for soles being purchased on the basis of superficial area. The area of the skins is generally determined by passing them through one special type of measuring machine. The investigation showed that the methods hitherto used in the testing of these machines have been inadequate. It was found that, in general, the readings of the machine were seriously in excess, due partly to over-speeding of machines, and partly to faults in their design. These errors have resulted in many cases in serious overcharges, amounting to large sums of money annually.

A detailed and constructive series of reports were prepared, intended to correct faulty methods of test and inspection, and to indi-

cate points of design requiring special attention. The brief investigation enabled a beginning to be made on the theory and design of these machines, and it is probable that during the coming year a code of specifications governing their use and test can be issued. Some information was collected regarding the shrinkage of skins from the time of tannage, a factor which results in an appreciable reduction in area, and is therefore important for consideration in connection with the standardization of methods for leather measurement.

### **Capacity Measures.**

The number of capacity measures submitted for test during the year was 56. These included standards for State governments, city governments, and for private firms.

### **Volumetric Glassware and Hydrometers.**

The volumetric apparatus submitted for test during the year consisted of Babcock bottles, burettes, cylindrical graduates, flasks, measuring pipettes, Giles flasks, specific gravity flasks, and transfer pipettes. About 1,370 pieces of apparatus were submitted for test, 61 per cent of the total passing the regular tests. There were about 980 hydrometers submitted, of which 683, or 70 per cent, passed the test. The number of pieces of special apparatus tested was 30.

Blue prints of a set of cone graduates, conforming to the specifications adopted by the Eleventh Annual Conference on Weights and Measures, were made and sent to various manufacturers.

### **Hæmacytometers.**

The manufacturers of hæmacytometers, instruments for determining the number of corpuscles in a given quantity of blood, suggested that the Bureau issue tolerances and specifications for this type of apparatus and take up the testing of such instruments regularly. This suggestion led to an investigation of the accuracy of the various type of hæmacytometers in use. It was found in the majority of cases that the user assumed a greater degree of accuracy for the results obtained than was warranted by the apparatus. In some instances the instrumental inaccuracies were of such magnitude as to cause errors in a count of from 25 to 100 per cent. This plainly indicated the necessity for accurately measuring the dimensions of hæmacytometer chambers and for calibrating hæmacytometer pipettes. Tentative tolerances and specifications have been issued which are meeting with general approval. Methods have also been devised for shortening the time required to test this type of apparatus.

### **Liquid-Measuring Pumps.**

The work begun last year on the investigation of liquid-measuring pumps, with especial reference to the gasoline pumps commonly used for dispensing motor fuel, was continued and extensive tours of inspection and test were made, principally in Illinois and Pennsylvania. The majority of the pumps tested were found in unsatisfactory condition, and in the aggregate a very decided and significant tendency toward a shortage of measurement was indicated. The Bureau has given considerable aid to weights and measures officials in developing

a routine for the testing of this type of apparatus and in detecting and correcting the defects developed.

Numerous inquiries were received from manufacturers, weights and measures officials, and users relating to the design and test of measuring pumps, and the preparation of the information sought in many cases required considerable investigation and study.

An extended code of measuring-pump specifications, in tentative form, has been drawn up and is about ready to be issued.

### **Gas-Measuring Instruments.**

During the past fiscal year a number of laboratory gas meters for both commercial and experimental work have been calibrated for State government, city, and industrial laboratories. Some of these instruments were calibrated at various rates of gas discharge, the results yielding valuable data as to the behavior of this type of apparatus under various conditions.

The investigation of gas-meter testing apparatus, continued from last year, has been carried on only to a very limited extent, due to lack of available time. This investigation has included the study of gas-meter provers and apparatus for testing the same.

The improved type of portable cubic-foot apparatus for calibrating meter provers designed and developed by the Bureau and which was mentioned in the report of last year has been further improved. A patent, dedicated to the public, has been granted on this apparatus. The cubic-foot apparatus in use in the past was extremely cumbersome, whereas the new apparatus can be easily carried about by one man and therefore will be of special value to the State inspector of meter-testing apparatus.

An important part of the work of the Bureau in this connection has been the instruction of officials of various cities in the methods of testing different types of laboratory and commercial gas-measuring instruments.

### **Weights and Balances.**

The shortening of the time required for testing ordinary analytical weights, begun last year, was carried out even more successfully than was expected when the work was first undertaken. The new balance for weights from 1 to 100 grams, when used under better conditions than had been tried before, had such constant sensitiveness that average values could be adopted for different loads, and these values needed to be checked only once or twice during a test. This reduced the number of readings by from 10 to 30 per cent. It also became possible to introduce the method of weighing by substitution in such a way as to reduce still further the number of readings required and at the same time to reduce the amount of handling of the weights. The computations are also greatly lessened in amount and much simplified. New forms were developed in which the complete work of observation and computation appear on the same sheet. These new forms were tried out in actual practice, perfected, and are now being printed for use in the laboratory. With a satisfactory balance for the smaller weights it will be possible to reduce the time required for testing by at least 30 per cent.

The Bureau tolerances for high-grade analytical weights were adopted by one of the large scientific apparatus houses and also by

a large commission association, through which about 30 of the constituent firms have been supplied with sets of standard weights such as are needed in their work. The adoption of these tolerances will enable manufacturers to furnish weights to distributors of scientific apparatus which will meet the specifications adopted by the Bureau. Consequently, when such weights are submitted to the Bureau for test they are more likely to be within the tolerances prescribed than if no attempt were made by manufacturers to comply with the specifications adopted by the Bureau, and thus a great saving in time is made in testing the weights.

Preparation is being made to test immediately any weights needed for war purposes which may be submitted by the various departments of the Government or by outside firms. To this end every effort is being made to keep the regular work as nearly up to date as possible, and extra balances are being overhauled with a view to using them should occasion arise.

#### **New Type of Balance.**

A novel type of balance, characterized by a high sensibility and yet very simple and inexpensive to manufacture, has been developed by a member of the staff and described in an article in a leading engineering periodical. The results of a preliminary test showed exceedingly good operation, and it appears that this simple and inexpensive balance compares in many respects very favorably with the more elaborate and costly analytical balances.

#### **Testing Scales by Use of Water.**

In compliance with a request for information as to the practicality of testing scales by the use of known volumes of water, determined by filling standard capacity measures, an investigation was carried out and very promising results were obtained. The object of using known volumes of water for testing scales is to enable a weights and measures inspector who does not have facilities for transporting large quantities of standard weights to test scales of large capacities.

#### **Track-Scale Work.**

The railroad track-scale work consists of that carried on at the Bureau and that done in the field. The work at the Bureau consists of the collection and distribution of information, the preparation of tolerances and specifications on track scales and other weighing devices, the development of the correct theory of scale design and construction, development of special devices and methods of tests, investigations of various problems that arise, and a study and selection of the problems to receive attention. An important feature of this work has been the interpretation, classification, and arrangement of the data collected in the tests made in the field.

The field equipment in operation during the year consisted of two test-weight cars of Bureau design, which have been described in previous reports. The field work comprised the testing of scales by means of the equipment provided, making a careful inspection of the scales and reporting their condition so that the owners may be advised by the Bureau what repairs or changes are necessary to

put the scales in proper condition. In addition to the testing of railroad-track scales and master scales, other scales of large capacity are tested when occasion arises. Additional field equipment has been purchased by the Bureau, but owing to war conditions it has not yet been delivered.

Representatives of the Bureau have cooperated with the various States in the preparation of specifications for railroad-track scales and have rendered advice to State officials in reference to technical details relating to their equipment. Assistance has also been given to various organizations, such as the National Scale Men's Association and the American Railway Association, in the preparation of reports, papers, specifications, and other matters pertaining to railroad-track scales.

### **Location, Condition, and Ownership of Track Scales Tested.**

Tests have been made in 21 States and the District of Columbia, the States being Alabama, Connecticut, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Missouri, Minnesota, North Carolina, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Virginia, West Virginia, and Wisconsin. In these States there were tested during the past fiscal year a total of 508 track scales, of which 158, or 44 per cent, passed the tolerance adopted by this Bureau. This tolerance is based on the maximum allowable error of a weighing of 200 pounds in weighing a car of 100,000 pounds gross weight. The results obtained from the test of 149 scales included in the total number mentioned above have not yet been compiled.

In cooperation with the American Railway Association, 15 master scales were tested on a schedule submitted by them and agreed to by this Bureau. Three of the 15 master scales tested were found to be within the tolerance during the test, and of the remainder 5 were not in condition to make the adjustment within the tolerance practicable. The tolerance applied to these master scales allows an error of 10 pounds in weighing a test car of 100,000 pounds.

These master scales are the practical means available to the railroads and to the various States for the standardization of test cars, which in turn are used for testing commercial scales.

The scales tested belonged to the Federal Government, State governments, corporations, railroads, and industrial concerns.

### **Reports on Track Scales Tested.**

Reports of track-scale tests had been rendered to the owners of these scales, the officials of those States which have organized departments of weights and measures, officers of weighing and inspection bureaus having jurisdiction over the scales, and to chambers of commerce. It became necessary, on account of the great pressure of other work to discontinue this practice toward the close of the fiscal year, but it will be resumed as soon as the present national emergency has passed.

These reports represent a very important phase of track-scale work. They give the results of tests in detail, show the conditions found by careful inspection, and make recommendations for correcting such faulty conditions as are present.

The owners of the scales have been given every opportunity to witness the tests, and the recommendations included in the reports have been for the most part carefully carried out. In many cases new scale installations have been made as a result of the tests and recommendations. The work thus carried on by the Bureau reduces the amount of shortage in weight due to faulty scales; creates confidence in the correctness of the scales between the railroads, shippers, and consignees; and tends to prevent disputes as to the correctness of the weights.

### **Technical Information Regarding Track Scales.**

Several communications were prepared on various technical matters relating to scales and weighing mechanisms, which were distributed to a general mailing list of people interested in this subject. One of these, "Specifications for Class C slotted counterpoise weights for scale testing," Communication B423, gave specifications for weights which had been found particularly suitable for conducting tests on railroad-track scales and railroad master scales, as well as being adapted for testing other kinds of scales, such as wagon scales, platform scales, etc.

One of the most serious problems that has to be met in maintaining a railroad-track scale is the corrosion of the parts induced by their being located in damp pits. This subject is covered in Communication B420, entitled "Protection of track-scale parts from corrosion," and is supplemented by Communication B426, giving specifications for paint for use on railroad-track scales. This is a compilation of information collected by the Bureau from outside sources and from work which is being carried on by the Bureau in other lines.

Communication B419, under the title of "General inspection and overhauling of track scales," gives the recommendations of the Bureau in regard to the character and frequency of scale inspection and overhauling.

Communication B421, under the title of "Alignment," points out and emphasizes the need for keeping the scale parts properly aligned and makes suggestions respecting certain details.

Communication B422, "Maintaining the multiplication of track scales," calls attention to some of the mechanical principles controlling the action of railroad-track scales, points out where an improvement can be made by eliminating certain faulty methods of adjustments, and shows how the test can be made in conformity with correct principles.

Communication B425, "Determination of actual sectional errors in railroad-track scales," points out how information necessary for the efficient adjustment of railroad-track scales can be obtained and properly employed.

Communication B424, entitled "Chart for adjusting levers of railroad-track scales," furnishes the practical scale mechanic in the field the information needed by him in making adjustments without employing mathematical computations.

Communication B414, "Types of construction to be avoided," points out certain defects, or incorrect principles, which have been used in many scales and which should be avoided.

Communication B413, "Explanation of reports on tests made of railroad-track scales," explains the method of presenting the information obtained in the various details of the test and inspection as reported to the owners of the scales.

Communication B430, "Weighing by substitution," explains a method whereby accurate weighing can be carried out on a scale which is not in itself accurate or is not intended for weighings of such precision as can be obtained by this method.

### **Building for Housing Master Scale.**

In order to provide a place for installing the 100,000-pound master precision scale purchased by the Bureau and to provide facilities for housing the field equipment while undergoing repairs and while being standardized, a suitable building is very urgently needed. This master scale will afford facilities both to the Government and to the railroads for standardizing their railroad-track-scale equipment and would also be available for the standardizing of any railroad-track-scale equipment such as is now owned by some of the weights and measures departments of the States. The installation of this master scale and building would also furnish a correct and efficient means of weighing and standardizing large projectiles, such as are occasionally submitted by the War and Navy Departments, and large guns can be weighed with precision.

### **Density Determinations of Materials.**

During the year density determinations of 156 samples of materials were made. These included samples of wood and special materials whose physical properties were investigated for the purpose of determining their suitability for airplane construction.

An investigation of the density and thermal expansion of sea-water and sodium-chloride solutions was carried out, the results of which were used for calibrating some instruments to be used in the rapid and accurate determination of the density of sea water.

### **New Sugar Tables.**

A new sugar table was calculated and will be included in Circular No. 44 of this Bureau when reissued. This table shows the relation between percentage of sugar, specific gravity of solution, and degrees Baumé, and is based on the work of Dr. F. Plato.<sup>a</sup> The Baumé degrees are according to the modulus 145.

### **Barometry, and Aeronautic Instruments.**

A short time before the close of the fiscal year the barometry section was extended in scope to include aeronautic measuring instruments in general, with the intention of placing all aeronautic measuring instruments on the same basis of scientific testing as was previously the case with altitude-measuring instruments only. A number of conferences with military officials, practical aviators, and manufacturers regarding the status of aeronautic instruments, both here and abroad, together with laboratory experiments on various types of instruments, have served to accumulate considerable information. The information thus gathered has enabled the Bureau

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<sup>a</sup> *Wiss. Abh. der Kaiserlichen Normal-Eichungs-Kommission* 2, p. 153; 1900.



to answer frequent inquiries and be of assistance, in turn, to other manufacturers and military authorities. As a single example, at the request of the joint trial board of the Army and Navy air services, a simple and definite system was prepared for the determination of airplane altitudes during acceptance test on airplanes. The cooperation had with manufacturers of aneroid barometers has led to definite improvements in the quality of the instruments produced, as is shown in detail by the records available in the laboratory.

On account of the large demand for information on aeronautic measuring instruments, it seems highly desirable to issue a circular of general information on these instruments, summarizing their uses and sources of error, and announcing the procedure governing tests at this Bureau. An outline which will form the basis of such a circular has been prepared.

Laboratory investigations in cooperation with military authorities have been commenced. This work has included a comparative study of the errors in the gauges used as speed indicators and also in various tachometers.

The Bureau is represented on the appropriate subcommittee of the National Advisory Committee for Aeronautics in connection with this work.

During the fiscal year routine tests were made on 2 mercurial barometers, 2 katanoscopes, 6 statoscopes, and 345 aneroid barometers. The latter number includes weather aneroids, surveying aneroids, thermobarographs, altimeters, and altigraphs.

#### **Watch Testing.**

Forty-five watches were submitted for test during the past year, about the same number as the Bureau received for test the previous year. All of these were submitted for the class A test, and 36 per cent of the total number passed the requirements and received a class A certificate. Thirteen of the 16 watches receiving certificates were of American make. The rate of the Riefler clock has continued satisfactory during the year.

#### **Lime-Barrel Act.**

At the first session of the Sixty-fourth Congress an act to standardize lime barrels was passed and was approved on August 23, 1916. The general provisions went into force and effect at once, and the penal provision became effective on January 1, 1917. This law regulates the sale of lime by establishing two mandatory standard barrels for use in interstate commerce, containing, respectively, 280 and 180 pounds net, and by requiring that packages of less capacity shall have the net weight of the contents stamped upon them. The Bureau is greatly in favor of the sale of commodities by weight, whenever such a method of sale is practicable, and it heartily assisted the committee of the National Lime Manufacturers' Association in drafting the original bill introduced into Congress and endorsed the principles represented therein.

#### **Rules and Regulations for Barrel Laws.**

The lime-barrel law provided that rules and regulations for the enforcement of the act, including tolerances to be allowed, should be made by the Director of the Bureau of Standards and approved

by the Secretary of Commerce. As soon as the law was passed, the Bureau conducted an investigation of the manner of sale of lime in barrels and packages, and rules and regulations were finally promulgated in accordance with the provisions of the law. These have met with the approval of the trade and are regulating the subject satisfactorily. A representative of the Bureau attended the annual meeting of the National Lime Manufacturers' Association and explained the provisions of the law and of the rules and regulations. The great majority of the manufacturers show a most commendable desire to understand these provisions and to comply with them.

The Bureau found the preparation of rules and regulations for tolerances, authorized by the standard-barrel act, a difficult undertaking on account of the dearth of information on this subject as well as the fact that it was necessary that those adopted be simple in their application, since the tests on barrels must be made in the field quickly and with rough apparatus. It became necessary to conduct investigations into the formulas heretofore published, and when these were found to be inaccurate for the type of barrel established by law a satisfactory metal standard barrel was constructed and a new formula derived applicable to this type of barrel.

A convenient method has been developed for representing on a single plane the variations of a quantity which depends on several variable quantities. This method has been applied particularly to the problems of representing the capacity of standard barrels corresponding to given measurements of the head diameter, the distance between heads, and the bulge circumference. Charts for this purpose which will be useful for those making inspections under the new standard-barrel act have been prepared and blue prints of them were made. The method has also been applied in slightly different form in the preparation of charts which will be of value to the manufacturer of barrels.

With the results so obtained as a basis, simple rules were worked out for field inspection by means of which it can be rapidly and accurately determined whether or not barrels in use comply with the requirements of the law. The rules and regulations thus formulated have been completed and approved, and they are now in the hands of the printer. When these are distributed, it is believed that the strict enforcement of the law will become practicable and that such enforcement will not result in any hardship to manufacturers or shippers.

### **Uniformity in Inspection of Weights and Measures.**

With the rapid spread of the inspection of commercial weights and measures throughout the country during the last few years, as evidenced by the passage of State laws and city ordinances on the subject, and the consequent appointment of official inspectors, the necessity of uniformity of laws, of specifications and tolerances for commercial apparatus, and of inspection methods is becoming more and more evident each year. The Bureau has succeeded in the past in making satisfactory progress in regard to uniformity of laws and of specifications and tolerances through the medium of the Annual Conference on Weights and Measures. There has now developed a great demand for a manual of inspection of apparatus to the end

that the specifications and tolerances adopted be uniformly interpreted and enforced and the practice standardized in the various jurisdictions. Many requests have reached the Bureau for a publication along these lines. There has been no publication heretofore issued which could be recommended as satisfactory. To meet this need and to satisfy these demands, the Bureau has prepared material on this subject, which is now about ready to go to the printer. This publication will probably be issued in the form of a compact manual designed especially for field use. It is believed that this publication will satisfy the existing demand and will do much to bring about a standard practice throughout the country, and a marked increase in efficiency should therefore result.

#### **Annual Conference on Weights and Measures.**

The Bureau had planned to hold the Twelfth Annual Conference on Weights and Measures in Washington during the month of June. After the date had been fixed upon and preliminary details had been worked out, the declaration by Congress that a state of war existed caused a complete revision of the plans. It appeared to the Bureau that no time could be devoted to this meeting by the members of the Bureau staff on account of the great press of very urgent business which was rapidly developing. It also appeared questionable, in view of the general necessity of economy in expenditure of money, time, and energy, whether the results which could be accomplished at this time would compensate for the expenditure involved in the holding of the meeting.

These matters were placed before the executive committee of the conference by the Bureau, with the recommendation that the contemplated meeting be postponed. The result was that the committee voted unanimously to postpone the proposed meeting indefinitely, and the Bureau believes that this was a wise decision. The meetings will be resumed when it appears that this can profitably be done.

#### **Cooperation with States and with Local Officials.**

During the past year the Bureau cooperated with State and local weights and measures officials by sending representatives to meetings of officials in the States of Indiana, Michigan, New Jersey, Pennsylvania, and West Virginia. Addresses were given on subjects connected with the work of the Bureau and the State and local departments, such as the test of railroad-track scales, the enforcement of the Federal barrel laws, etc. On account of the postponement of the national conference, the State meetings were of especial importance this year. The State of New Hampshire joined the list of States having adequate laws on the subject of weights and measures by passing a bill drafted and recommended by the Bureau and based on the model law heretofore adopted, establishing a State-wide inspection service. This State was the last one in New England which did not furnish such protection to its citizens. Several other States passed bills strengthening their local laws, and in still others bills recommended and indorsed by the Bureau were considered but failed of passage through various causes. A number of State and local officials visited the Bureau for the purpose of obtaining assistance and information, and as usual much information was furnished and many problems considered through the medium of correspondence.

### Information Furnished on Weights and Measures Subjects.

Much information and advice on technical matters have been furnished, of which the following may be mentioned: Use of spring scales in the United States, especially with reference to the general points to be considered in permitting the spring scale to be used in trade; weighing scales and gasoline-measuring pumps furnished to writers for use in articles for technical magazines; the design of weighing scales furnished on request of manufacturers and private individuals; the relative precision of equal arm balances and platform scales with reference to the weighing of precious metals; the design of certain weighing scales for use in the Philippine Islands; and tolerances and specifications applying to apparatus used in the testing of water meters. Specifications were furnished for a large automatic scale, a scale for weighing paper to be used in the Division of Supplies of the Department of Commerce, and a weighing apparatus listed in the Government schedule of supplies. A great amount of information has been furnished on the density, pounds per cubic foot, and pounds per gallon of various substances; the design of an epicyclic train for an automobile speedometer; the adaptability of a certain device for the measurement of molasses in tanks; the graphical methods of calculation used by the Bureau; and the mechanical design of a paper-reeling device.

### 2. HEAT AND THERMOMETRY.

[Temperature, heat, heat constants, melting and boiling points, critical points, specific heats, conductivities, and other thermal properties of materials, including researches on heat units and standard temperature scales, standardization of instruments and methods for measuring temperature, determination of refrigeration data and the fire-resisting properties of materials and other experimental work of specific value to the refrigerating and heating industries, in the manufacture of thermal appliances, in scientific testing and laboratories, in fire-safety engineering, and in the industries and sciences requiring precise knowledge of temperature measurements and heat constants.]

### New Regulations Governing Tests of Clinical Thermometers.

New regulations governing the testing of clinical thermometers have been adopted, effective July 1, 1917. The former regulations provided for tests at four points—96°, 100°, 104°, and 108° F.—and certificates giving the corrections found were issued, provided that the corrections did not exceed 0.3° and that the thermometers were free from defects. Extensive inquiries among users of clinical thermometers had shown that the corrections given on such certificates were rarely applied, and that most users preferred a “blanket” certificate stating that the readings of the thermometers were correct. The new regulations provide for tests at two points—98.6° F. (37° C.) and 104° F. (40° C.)—and the thermometer is certified as correct if the corrections at the lower and upper test points do not exceed 0.1° and 0.2° F., respectively. The certificate also states that the thermometer has been aged at least one month and that subsequent changes due to aging will probably not exceed 0.1°. The latter statement would be true only if the bulbs of the thermometers were made of a suitable thermometric glass, for if the bulbs were made of soft glass the indications of the thermometer might change by a degree within a year. However, by making two tests at intervals of a month, the inferior thermometers can be detected and rejected.

A new and distinctive certificate bearing the seal of the Bureau of Standards has been prepared by the Bureau of Engraving and Printing. A number of manufacturers had been issuing their own certificates upon forms similar in appearance to those used by the Bureau, and the wording of some of these certificates was such as to give the impression, at first sight, that the certificate had actually been issued by the Bureau of Standards. It is hoped that the Bureau's new certificate will become so well known that its distinctive character will prevent such deception.

Circular No. 5, Testing of Clinical Thermometers, has been revised to include the new regulations and will be ready for distribution early in July, 1917.

### **Standard Temperature Scale.**

For a number of years the standard scale of temperature used by the Bureau in the intervals  $-50^{\circ}$  to  $0^{\circ}$  and  $+100^{\circ}$  to  $500^{\circ}$  C. has been the scale defined by the platinum resistance thermometer calibrated at three points,  $0^{\circ}$ ,  $100^{\circ}$ , and  $444.6^{\circ}$ , the boiling point of sulphur. The standard scale in the interval  $0^{\circ}$  to  $100^{\circ}$  has been the hydrogen scale of the International Bureau of Weights and Measures and is represented by the corrected indications of a number of verresdur thermometers which had been calibrated by the International Bureau.

The great precision and reproducibility of the scale defined by the resistance thermometer have led to the adoption of this scale over the whole range from  $-50^{\circ}$  to  $+500^{\circ}$ . It has long been known that this scale does not differ appreciably in the range  $0^{\circ}$  to  $100^{\circ}$  from the hydrogen scale previously in use by the Bureau. It has been considered desirable, however, to determine as definitely as may be the outstanding difference between the two scales, and some of the intercomparisons have been made.

Since the work involves the determination of a minute difference, no statement as to results will be of value until the work is completed. Assurance may be given, however, that the adoption of the new standard scale will produce no recognizable change in the temperature scale distributed by the Bureau through the medium of its testing work.

### **Copper-Constantan Thermocouples.**

Some progress has been made during the year in the design of a suitable inclosure for copper-constantan thermocouples and in the preparation of couples to be used in determining a standard calibration curve for such couples in the temperature range from  $-200^{\circ}$  to  $+300^{\circ}$  C. The great utility of thermocouples and their extensive use would make such a calibration very valuable.

### **Depression of the Ice Point of Thermometers.**

The work on the depression and recovery of the ice points of thermometers has been practically suspended during the year, due to difficulty in obtaining suitable thermometers made of American thermometric glasses, which should be included in such an investigation. It is hoped that this work will be finished in the near future.

### Standard Boiling Points.

The method referred to in the annual report for 1916 for determining the variation with pressure of the boiling point of sulphur has been used to determine the variations for naphthalene, benzophenone, and anthracene, over the pressure range from 700 to 800 run of mercury. The suitability of the boiling points of naphthalene and benzophenone to define standard temperatures was well known. Anthracene has been found to be satisfactory in that a given sample has a definite boiling point not changing with continued boiling, but the samples used differed considerably. With the aid of the chemical division, it is proposed to determine whether it is feasible to purify anthracene so that its boiling point may serve to define a thermometric fixed point. The results of this work will probably be ready for publication within a year.

### Standard Heat Samples for Use in Calorimetry.

The Bureau has continued the distribution of naphthalene and sucrose as standard heat samples. The stock of naphthalene was renewed. Owing to inability to renew the stock, the distribution of benzoic acid has been temporarily discontinued. A total of 239 samples, consisting of 32 of benzoic acid, 118 of naphthalene, and 89 of sucrose, was issued during the year. These samples serve an important purpose in enabling commercial laboratories and others to obtain reliable results in fuel testing. Cases of dispute between buyer and seller, due to discrepancies between results of their tests, were not infrequent a few years ago, but no such cases have come to the attention of the Bureau for a number of years.

### Standard Samples for Thermometric Fixed Points.

In addition to the service which the Bureau is able to render scientific workers and the industries by calibrating pyrometers, there has been a demand for some means by which the user of pyrometers might be able to calibrate his own instruments. Pure metals of known melting points provide a satisfactory means for this purpose, and during the past two years the necessary materials were obtained.

The Bureau now has available for distribution samples of pure tin, zinc, aluminum, and copper. The melting points of these materials have been accurately determined with standardized platinum resistance thermometers, and chemical analyses showing a very high degree of purity have been made. These materials are intended for use primarily in the standardization of rare metal thermocouples and the samples are of suitable size (50 to 80 cubic centimeters) for this purpose. Circular No. 66, describing the preparation and methods of use of these samples, is now in press. The distribution of the samples will begin about August, 1917.

### High-Temperature Investigations.

Some work was done on the standardization of pyrometer lamps that had also been carefully calibrated at several industrial laboratories as a basis for the intercomparison of the high-temperature scale actually being used in the several laboratories in important researches, the temperature scale being that defined by the optical pyrometer up to 2,500° C.

On account of its important bearing on the use of optical methods of temperature measurements, some work was done, as time would permit, on the change in the effective wave length of pyrometer color screens.

Considerable progress has been made on the construction of an electric furnace, capable of operation up to  $1,800^{\circ}\text{C.}$ , for work on the melting points of palladium and platinum, two very important fixed points of the high-temperature scale.

New methods have been developed and introduced into the laboratory for testing thermocouples, which not only increase the accuracy but very materially reduce the time required for the tests. These have made possible large increases in the testing work accomplished.

Work has been done on the development of a "neutral" absorbing screen for optical pyrometers, such screens being generally made of foreign glasses not now available.

In conjunction with the metallurgical division, standard melting-point samples have been prepared for distribution, as explained in the preceding section.

### **Low-Temperature Laboratory.**

The carbon dioxide system has been operated almost continuously to supply refrigeration to the thermostatically controlled baths used for the refrigeration constants investigations and to the low-temperature thermometer comparator.

The capacity of the air liquefier has been brought up to 12 liters per hour. Liquid air has been made 34 times during the year, as required by the various Bureau and other Government and college laboratories. A number of demonstrations have been given to technical societies visiting the Bureau, to science classes of several educational institutions, and to other public organizations.

The air compressor has in addition been operated on 23 occasions to supply compressed air for the low-temperature baths of the thermal expansion laboratory. The large air compressor is at present operated by steam. Electric power should be substituted to relieve the heavy demands on the Bureau's boiler plant.

The electrolytic gas generator has maintained a supply of hydrogen and oxygen for general use throughout the Bureau. The acetylene generator has been kept in operation to supply acetylene gas as needed.

A hydrogen liquefier was made in the laboratory, and an old compressor that was purchased with the plant was overhauled, a small compressor was improvised into a vacuum pump for precooling air, and liquid hydrogen was produced in this laboratory during the year. Six liquid hydrogen runs were made.

Good progress has been made by the instrument shops on the construction of a new hydrogen liquefier, the designs for which were worked out last year. To produce liquid hydrogen in such amounts as to be of real use to the Bureau's laboratories, as well as to other investigators who may desire to avail themselves of this unusual laboratory facility, a new 4-stage compressor, two gas storage tanks, and some lesser equipment should be provided.

Considerable time has been given to overhauling the extensive mechanical equipment of the laboratory. Some time has also been

given to preliminary experiments in connection with military problems.

### **Mercury Vapor Pump.**

An improved mercury vapor pump has been developed which will give a high vacuum when used in conjunction with any pump which will evacuate to a primary pressure of 4 centimeters or less. The pump works by two stages in connected units, each operated by mercury vapor from a single boiler, a single gas burner being used to evaporate the mercury. The pump is simple in construction and can be built by a reasonably skilled glass blower. Pressures much lower than 0.0001 millimeter may be quickly reached with the pump.

### **Refrigeration Constants.**

This extensive series of investigations, undertaken at the request of American refrigeration engineers, expressed through their national associations, includes the determination of the fundamental constants of refrigeration engineering. The work is being carried out with the cooperation of committees of the American Association of Refrigeration and the American Society of Refrigerating Engineers, the members of which have kept in close touch with the work by visits to the Bureau and by means of the reports presented before the annual meetings of these societies by members of the Bureau's staff. The complete series of investigations contemplated under this topic was outlined in the annual report for 1916. The work done during the year is briefly summarized in the following sections.

### **Calorimeter for the Determination of Latent and Specific Heats of Fluids.**

The principle of the unstirred or "aneroid" type of calorimeter has been embodied in an instrument especially designed for determinations of the specific heat and latent heat of several substances in general use as refrigerating media.

Heat developed electrically in a coil located in the central axis of the cylindrical shell comprising the calorimeter is distributed by conduction to the calorimeter and contents, whose initial and final temperatures when in thermal equilibrium are measured by a platinum resistance thermometer.

Heat from other sources is excluded by enveloping the calorimeter with a metal jacket separated from it by an air space and keeping this jacket during measurements at the same temperature as the calorimeter surface, using multiple thermocouples to indicate this equality.

The calorimeter is adapted for use between  $-50^{\circ}$  and  $+50^{\circ}\text{C}$ . and for pressures up to 70 atmospheres in experiments where the measured heat added is used either to change the temperature of the contents or to evaporate a portion of the contents withdrawn as superheated vapor, in the first case the specific heat and in the second the latent heat of vaporization being obtained when proper corrections are made.

A paper is now in press describing the details of construction of and the special features embodied in this instrument, the methods



of manipulation in making measurements of the heat capacity, and giving the results of an extended series of observations in the temperature range from  $-50^{\circ}\text{C.}$  to  $+50^{\circ}\text{C.}$  to determine the heat capacity of the empty calorimeter.

### Specific Heat of Liquid Ammonia.

Using the above described calorimeter, the specific heat of liquid ammonia has been determined throughout the temperature interval  $-45^{\circ}$  to  $+45^{\circ}\text{C.}$  under saturation conditions.

Two distinct and independent methods were used, each of which avoids sources of error possessed by the other. In the first method measurements were made of the heat added to a fixed amount of ammonia confined in the calorimeter at saturation conditions, and also the resulting changes in temperature. By using data for the specific volumes of the two phases and the latent heat of vaporization, the corrections for vapor are applied, giving the specific heat of the liquid, kept saturated, as a function of the temperature.

In the second method the calorimeter is kept full of liquid at a constant pressure. The heat added to a variable amount in the calorimeter and the resulting change in temperature were measured. A correction for the heat absorbed by the expelled liquid, depending on the lag of this part with respect to the entire contents, was determined by a novel thermometric device. By use of data for the latent heat of pressure variation of the liquid, obtained from separate measurements made with the same apparatus and material, the corrections for pressure variation were applied, giving an independent determination of the specific heat of the liquid, kept saturated, as a function of the temperature.

The greatest difference between the mean results of both methods, and the results of either method as represented by empirical equations, is less than 1 part in 1,000.

A form of empirical equation was found which, in addition to representing closely the results in the range of temperature covered experimentally, conforms to several theoretical considerations regarding the behavior of substances in general when approaching the critical temperature.

As a final result the specific heat  $\sigma$ , in joules (international electric watt-seconds) per gram per degree centigrade, of liquid ammonia, kept saturated, in terms of the temperature  $\vartheta$ , in centigrade degrees, is expressed in the interval  $-45^{\circ}$  to  $+45^{\circ}\text{C.}$  by the equation

$$\sigma = 3.1365 - 0.00057\vartheta + \frac{16.842}{\sqrt{133 - \vartheta}}$$

A paper giving all the necessary details of this investigation has been prepared and sent to press.

### Latent Heat of Vaporization of Ammonia.

Using the above-described calorimeter, the latent heat of vaporization of ammonia has been determined throughout the temperature interval  $-42^{\circ}$  to  $+52^{\circ}\text{C.}$

An analysis of the process occurring in the calorimeter during an experiment leads to a method of calculation of the results whereby data from other sources than the direct calorimetric observations

enter only in the computation of correction terms which can by careful manipulation be made small.

Variations in manipulation were introduced as a means of detecting possible systematic errors, particularly in regard to the matter of dryness of the vapor withdrawn.

The results of each of the 34 determinations agree with the mean result as expressed by means of an empirical equation within 1 part in 1,000. An empirical equation was found which, in addition to representing closely the results in the range of temperature covered experimentally, conforms to what is known about the behavior of substances in general when approaching the critical temperature.

As a final result the latent heat of vaporization of ammonia—that is, the heat required to convert saturated liquid into saturated vapor at constant temperature—in joules per gram is expressed in the range  $-42^{\circ}$  to  $+52^{\circ}$  C. by the equation:

$$L = 137.91\sqrt{133 - \delta} - 2.466(133 - \delta)$$

If the latent heat of vaporization be expressed in calories<sub>20</sub> per gram, taking 1 calorie<sub>20</sub> = 4.183 joules, the equation becomes

$$L = 32.968\sqrt{133 - \delta} - 0.5895(133 - \delta)$$

Using the results obtained for the latent heat of vaporization of ammonia together with the specific heat of the saturated liquid, the specific heat of the saturated vapor has been computed for various temperatures and given in a table.

A paper giving all the necessary details of this investigation has been prepared and will be sent to press shortly, after final revision by the editorial committee.

#### Latent Heat of Pressure Variation of Liquid Ammonia.

The latent heat of pressure variation of liquid ammonia—that is, the heat gained or lost per unit pressure change at constant temperature—has been determined as a supplement to a series of specific-heat measurements upon the same material, in order to furnish data for correlating the measurements made at constant pressure with those made under saturation conditions.

Three independent methods were used in the present investigation, the first by direct calorimetric measurement of the heat transformed in consequence of a change of pressure, the second by computation from the expansivity directly observed with a dilatometer, and the third by computation from the specific volume of the saturated liquid at various temperatures and the compressibility.

The apparatus used in the measurements consisted of the aneroid calorimeter with accessories.

The results of the three independent methods were in agreement to the order of precision of the measurements. In temperature interval  $-40^{\circ}$  to  $+40^{\circ}$  C. and range of pressures from 20  $\frac{\text{kilograms}}{\text{square centimeters}}$  to saturation, the results are represented by the empirical equation

$$l = 0.037 - \frac{15}{120 - \delta}$$

where  $l$  is the latent heat of pressure variation in joules per gram for a pressure variation of 1 kilogram per cubic centimeter. The variation of  $l$  with pressure in the range here covered was found to be small enough to be negligible in the application of the results to the specific-heat investigation.

### **Specific Volumes of Ammonia in the Liquid and Vapor Phases.**

The specific volumes of ammonia in the liquid phase were measured in the temperature interval  $-45^{\circ}\text{C.}$  to  $+45^{\circ}\text{C.}$  with an accuracy of about 0.01 per cent. A large number of measurements of the specific volumes in the vapor phase were made in glass containers in the temperature interval  $-50^{\circ}\text{C.}$  to  $+50^{\circ}\text{C.}$ , most of the work being confined to the low temperatures. Experiments were made to determine the magnitude of the adsorption of ammonia on glass surfaces. The insertion of a large number of small, thin-walled glass tubes within the largest glass container used in these specific volume experiments increased the surface area by a factor of approximately 10. Measurements made in these two tubes of such different surface areas, in the interval  $-50^{\circ}\text{C.}$  to  $+50^{\circ}\text{C.}$ , showed that the measurements of the specific volumes of the vapor in glass containers were not affected by adsorption by an amount exceeding the experimental errors of the specific volume determinations.

The additional measurements at the higher temperatures (above  $0^{\circ}\text{C.}$ ) required to complete this investigation will, it is expected, be completed during the present summer.

As an independent check on the results found by the above method, an apparatus is being constructed for the determination of the refractive index of the vapor throughout the above temperature interval, making use of the well-known relationship between refractive index and specific volume. It is hoped that this method will accelerate the work and increase the accuracy attainable, especially at the lower temperatures.

### **Compressibility of Liquid Ammonia.**

The compressibility of liquid ammonia is required in computations relating to other important refrigeration constants of this fluid. The special apparatus required for this work was completed, and the preliminary measurements made with it indicate that the more important experimental difficulties have been overcome so that the investigation can probably be completed at an early date.

### **Density-Temperature-Concentration Relations of Aqua Ammonia.**

Work has been continued on the determination of the density-temperature-concentration relations of aqua ammonia for solutions of 5 to 30 per cent by weight of ammonia over the temperature interval from their freezing points to about  $40^{\circ}\text{C.}$  The experimental work in connection with this investigation has been nearly completed.

### **Pressure-Temperature Relation for Vapor in Equilibrium with Aqua Ammonia.**

The apparatus required for the determination of this relation, of importance in the design and operation of absorption refrigerating systems, has been nearly completed. Aqua ammonia of known con-

centration, as determined by volumetrically measuring its constituents, is introduced into a glass vessel provided with an electromagnetic stirrer which operates in the completely closed vessel without mechanical connection to the outside. A connecting tube filled with mercury transmits the pressure to the pressure gauge, while the temperature control is obtained by immersing the vessel in a thermostatically controlled bath. A temperature range of  $-40^{\circ}\text{C}$ . to  $+125^{\circ}\text{C}$ ., a concentration range of 0 to 50 per cent, and a pressure range of 0 to 15 atmospheres are provided for by the apparatus designed.

It is hoped that the necessary measurements may be made within the near future.

#### **Temperature-Concentration Relation for Vapor in Equilibrium with Aqua Ammonia.**

Most of the instrument shop work in connection with the apparatus required for the determination of this relation, of importance in the design and operation of absorption refrigerating systems, has been completed, and it is hoped that an opportunity will be found to make the necessary measurements during the next fiscal year.

Following is a brief description of the method adopted. The steel container, half full of aqua ammonia, is immersed in a thermostatically controlled bath. Vapor is drawn off from the top, run through a condensing coil, and returned to the bottom of the container. When equilibrium is established, the concentration of the vapor phase is determined from measurements of the density of the condensate, and of the liquid phase by density measurements of a sample drawn from the container. Densities are determined in slightly enlarged hydrometer cells forming part of the circulating system. The hydrometer consists of a glass float inclosing a silicon steel magnetic armature. Gravity control, with a series of removable platinum weights, serves to determine the large steps in density, and interpolation by means of the force exerted by a current in a solenoid acting on the steel armature gives the small steps.

To insure equilibrium of the vapor and liquid phases, a special device has been designed and constructed which will not only thoroughly agitate the liquid but expose a large fresh liquid surface to the vapor. The device consists of a paddle resembling a lawn-mower cylinder operated by a nutating rod through a flexible diaphragm which eliminates stuffing boxes.

#### **Specific Heats of Sodium Chloride Brines.**

The measurements of the specific heats of sodium chloride solutions were carried out with the large Dewar flask calorimeter previously used in the work on calcium chloride solutions. Measurements were made with solutions of chemically pure salt of 5, 10, 15, 20, and 22.5 per cent of salt by weight, respectively, with solutions of several commercial samples of sodium chloride of 20 per cent of salt by weight, and in the temperature interval  $-20^{\circ}\text{C}$ . to  $+30^{\circ}\text{C}$ . The pure salt was especially prepared for this work in the chemical division, and the work on the density-concentration relation of these sodium chloride solutions was carried out in the division of weights and measures. The experimental work in connection with

this investigation has been completed, but time has not been available to prepare it for publication.

### **Chemical Investigations Relating to Refrigeration Constants.**

Two investigations under the program of refrigeration constants have been carried out in the chemical division, one relating to the composition and testing of commercial anhydrous ammonia and the other to the formation and avoidance of noncondensing gases in ammonia refrigerating systems. The preparation of the pure material,—anhydrous ammonia, sodium chloride and its solutions, ethyl and methyl chlorides,—for use in the determination of the physical properties, has also been carried out in the chemical division. These results of these investigations are summarized elsewhere in this report.

### **Thermal Conductivities of Insulating and Structural Materials.**

The results of measurements of the thermal conductivities of a number of insulating materials were published in the September issue of the *Journal of the American Society of Refrigerating Engineers*. Since the date of that publication, measurements have been made on several other materials and on some 10 samples of panel board.

The greater part of the elaborate equipment required for the determination of thermal conductivities of structural materials has been completed in the instrument shops. The apparatus is being adapted for measurements up to 800° C. (1,500° F.).

### **Fire-Resisting Properties of Structural Materials.**

The object of the investigations on the fire-resisting properties of structural materials is to furnish architects, construction engineers, builders, State and city building bureaus, insurance interests, and others with fundamental engineering data relating to the behavior and safety of various types of building material and construction when exposed to different conditions met with in fires.

### **Fire Tests of Building Columns.**

Many millions of dollars are spent annually on the construction of buildings, the integrity of which, in the event of fire, is dependent on the behavior of the steel columns supporting the structures. Very little engineering data are available which would permit of any certain conclusions as to the thickness and kind of fireproof covering required to render these columns safe under various conditions of fire hazard. The requirements of city building codes on these questions are so different that it is evident that either some codes are requiring unnecessarily thick fireproof coverings, with undue increase in construction costs, or else other codes are requiring too thin coverings, with undue increase in danger to the stability of the structure under the existing fire hazards.

The fire tests on building columns are being conducted jointly by The National Board of Fire Underwriters, the Associated Factory Mutual Fire Insurance Companies, and the Bureau of Standards. The present program of tests was formulated after consultation with many engineers and architects interested in fire-resisting building construction.

*Types of Columns.*—The types of columns being tested include rolled steel sections, built-up steel sections, round cast-iron sections, steel pipe filled with concrete, vertically reinforced and hooped concrete columns, and wooden columns. At least one of each of the sections is unprotected, others are partially protected by filling the reentrant portions with concrete, and others are completely protected by various thicknesses of concrete, clay tile, filled and unfilled gypsum blocks, plaster on metal lath, and common brick, in accordance with the methods commonly employed in practice.

*Materials.*—The materials used in the construction of the test columns and protective coatings have been obtained from various sections of the country and have been selected with a view to obtaining those representative of their respective classes.

The column coverings have been applied by experienced men in accordance with plans and specifications drawn to secure average results obtainable under ordinary commercial conditions.

*Methods of Test.*—In the fire tests the column, mounted within a gas-fired furnace and kept under normal working load applied by a hydraulic ram of special construction, is exposed to a predetermined furnace temperature rise until the column fails. A record of the temperature at different points within the furnace and at various points within the test sample is obtained by means of suitable thermocouples. The deformation of the column from time to time is determined by means of pairs of nichrome wires inserted into the column at a known distance apart and extending horizontally outward through the walls of the furnace, the wires being run coaxially through fire-clay protecting tubes.

In the fire and water tests, the column is exposed to a furnace temperature built up at the same rate—i. e., in accordance with the standard time-temperature curve that has been adopted for these tests—until the desired temperature rise in the furnace is attained, when two opposite walls of the furnace are rolled out of position by means of trolleys provided for this purpose and the hose stream applied.

*Status and Sequence of Tests.*—The column coverings have all been applied. During the latter part of the present fiscal year, the preliminary work incident to adjusting burners to secure uniformity of temperature, to securing satisfactory operation of the ram, to calibrating gauges, etc., and to making several preliminary fire tests on filled pipe columns, was conducted, and on June 28 the first fire test of the regular program was successfully completed. Several fire tests have been made, and they give promise of yielding results of far-reaching importance in building construction.

The following tabulation shows the fire tests and the fire and water tests, classified according to the type of covering:

Fire tests of columns:	Number of tests.
Partial concrete protection.....	9
Full concrete protection.....	24
Reinforced concrete.....	6
Plaster on metal lath.....	5
Filled pipe.....	4
Clay.....	18
Gypsum.....	5
Common brick.....	2
Timber columns.....	4
Fire and water tests of columns: various types of coverings.....	13

No schedule has been decided upon for testing the unprotected columns, it being the present plan to test them as opportunity affords.

*Witnessing Tests.*—Underwriters, engineers, architects, and others having a proper interest in the subject are cordially invited to visit the laboratories, when in Chicago, and witness one or more of the tests in progress. The time for the tests is scheduled each week in advance and may be ascertained through inquiry by letter, telegraph, or telephone addressed to Underwriters' Laboratories, 207 East Ohio Street, Chicago.

A brief prospectus of the proposed tests containing somewhat fuller information than the present brief report is about to be issued.

#### **Fire Tests of Reinforced Concrete Columns.**

The program of cooperative tests, now under way at Chicago, includes but six columns of the reinforced concrete type of construction. When this program was prepared, it was, of course, realized that the number of such tests included at the time was wholly inadequate to determine the many possible variables that enter as important factors into reinforced concrete column construction. At that time, however, the several laboratories cooperating in the tests referred to did not see their way clear to laying out a program more extensive than the one adopted, which would require at least three years for its completion. Accordingly, the question of planning a comprehensive series of fire tests of reinforced concrete columns was deferred until the tests of the structural steel columns should be completed.

Whatever action may finally be taken with respect to the preparation of an elaborate program of fire tests of reinforced concrete columns, the Bureau concluded that the preparation of such a program, when it is finally taken up, would be very greatly facilitated if there were available fire tests of a number of such columns of representative types of construction. Accordingly, during the present year, the panel furnace at the Pittsburgh laboratories of the Bureau has been modified to adapt it to such tests, a 600-ton hydraulic ram has been installed to apply a continuous follow-up load to the column in the furnace, and about 30 reinforced concrete columns have been cast. The columns include square and round sections, 16 by 16 inches and 18 inches diameter, respectively, by 8 feet in length, aggregates of different types, and different methods of reinforcement. The temperature within the column, during the progress of the test, while the temperature of the furnace is being raised at the predetermined rate called for by the standard time-temperature curve adopted for all such tests, is measured by means of thermocouples imbedded in the columns at various distances from the surface.

During the last few weeks of the fiscal year, several successful preliminary fire tests were made on some extra columns that had been cast for the purpose, in order to test the new equipment and to standardize the procedure.

#### **Thermal Efficiencies of Column Coverings.**

A comparison of the thermal efficiencies of the materials commonly used for column coverings has been completed at the Pittsburgh Laboratories of the Bureau during the year. A short paper giving a summary of this work and entitled "A comparison of the heat

insulating properties of materials used in fire-resistive construction" was communicated to the annual meeting of the American Society for Testing Materials in June, 1917. This comparison of the materials themselves was preliminary to the investigations relating to the fire-resistive properties of structural units.

Solid cylindrical test specimens, 20 centimeters (8 inches) diameter by 40 centimeters (16 inches) length, were given the same heat exposure in a special gas-fired furnace. The rates of temperature rise at four depths within the specimen were measured by means of thermocouples mounted in 6-millimeter ( $\frac{1}{4}$  inch) holes extending longitudinally through the cylinder. Cylinders, similar to the cylinder under test, were placed at each end of the latter, in good contact with its end faces, to minimize the disturbing effects of heat losses from the ends. The materials included in these tests were: (1) Clays of the type used in the manufacture of hollow-tile fireproofing; (2) concretes, including two proportions of a number of aggregates; (3) gypsums; (4) lime mortar; (5) one specimen of a new material. The results are now being prepared for publication.

#### **Strength of Steel at High Temperatures.**

Some preliminary tests made in these laboratories two years ago on the ultimate compressive strength of short lengths of steel tubing showed that at 600° C. the ultimate compressive strength had decreased to 60 per cent, and in the next 50° C.—that is, at 650° C.—to about 30 per cent of its value when cold. On account of the great importance of such data in their bearing on the behavior of structural steel building construction when exposed to fire conditions, special apparatus has been designed for a more complete investigation of the elastic properties of metals at high temperatures. Contracts were placed in June for the construction of this apparatus, and it is expected that measurements with it may be started in the early winter.

#### **Panel-Testing Furnace.**

This furnace, together with its accessories, designed to test wall and partition structural units as large as 12 by 16 feet, was installed last year, and was described in the last annual report. Seven additional panel frames required to complete the plant should be installed as soon as the necessary funds can be provided. Arrangements have been made with a committee of ship constructors and operators to make a few fire tests of specially constructed panels with a view to improvement in the fire-resisting construction of passenger-carrying ships.

Steps have been taken to secure the cooperation of prominent engineers, representatives of engineering and technical societies, and manufacturing associations in the formulation of a comprehensive program of tests of the fire-resisting properties of various types of partition and wall construction. These tests are necessarily expensive, requiring as they do the test to destruction of large structural units. Very little progress on such an elaborate program of tests is possible until the appropriations available for the work are secured.

#### **Building Codes, Information, Cooperative Work, etc.**

Considerable correspondence has been carried on with engineers, State fire marshals, fire department officials, and others interested in



fire-prevention work, and the Bureau has cooperated with committees of the National Fire Protection Association in their several lines of work, especially with the committees relating to State building codes, safety to life, etc., and with the Bryn Mawr Fire Prevention Committee in their investigations on the fire hazard in relation to factories in which women are employed.

Work has been done in preparing an index for collating information relating to the fire-resisting features of building construction and in collecting data on the causes of fires.

A section entitled "Fires in the home" has been prepared as a part of a new Bureau circular, "Safety for the household," now in course of preparation.

#### **Activities in Technical Societies, etc.**

Members of the heat and thermometry division have cooperated with committees of the Society of Automotive Engineers on various aeronautical problems; committees of the American Society of Refrigerating Engineers on various problems relating to refrigeration engineering, several papers being presented before that society on the refrigeration constants investigation under way in the laboratories of the Bureau; committees of the National Fire Protection Association, the American Society of Testing Materials, and the Bryn Mawr Fire Prevention Committee on various problems relating to the fire hazard, safety to life, standardization of fire tests, etc.; the American Society of Testing Materials on the standardization of a new flash-point tester; the joint committee of the Bureau of Standards and the Bureau of Mines on Standardization of Motor Fuels; and with similar bodies.

#### **Information Furnished, Reports, etc.**

Several hundred special letters and reports relating to the work of the heat and thermometry division were prepared during the year in compliance with requests for information addressed to the Bureau by engineers and technical men, scientific investigators, national, State, and municipal bureaus and laboratories, etc. The subjects are treated in detail below.

*Instruments, Apparatus, Materials and Methods of Test.*—Mercury thermometers, resistance thermometers, thermocouples, optical and radiation pyrometers, including such questions as specifications, choice of instrument, installation and protection, methods of use, precautions in use, etc., thermometer bridges and thermocouple potentiometers, thermostats, thermometer comparators, annealing ovens, electric and gas furnaces, gas and fuel calorimeters, high-vacuum pump, refractories, methods of testing insulating materials, refractory materials, fire-resisting properties, heat-resisting properties of glass, etc.

*Scientific Data.*—Thermal conductivities of metals and insulators, freezing points, melting points, specific and latent heats, heats of reaction, heat losses by convection, and transmission of heat through air spaces.

*Properties of Materials.*—Resistance of materials to heat, expansivity and melting points of fire brick, properties of mica, heating values of fuels, insulating value of various materials, and properties of porcelain.

*Gasoline and Oils.*—Addition agents for gasoline, danger of explosion in filtering gasoline, gasoline substitutes, motor fuels, aero engine tests, specifications for oils and gasoline, etc.

*Miscellaneous.*—House heating, control of temperature and humidity, refrigerators, radiators, impurities in commercial ammonia, liquid air, freezing of fire extinguishers, fireproof safe cabinets, manufacture of various materials, etc.

#### Heat and Thermometric Apparatus Tests.

During the year, 2,303 mercurial thermometers of various kinds were submitted for test, of which 2,189 were certified. Among those submitted were 215 ordinary calorimetric thermometers, 68 precision calorimetric and Beckman thermometers, 16 clinical standards, and the remainder laboratory and special thermometers of various types and ranges from below 0° to 500° C. About 2 per cent were received broken and about 0.8 per cent were broken in the process of testing.

Twelve thousand four hundred and six clinical thermometers were submitted for test; of these, 11,670, or 94.1 per cent, were certified. The percentage rejected amounted to 5.9 of the total number submitted; 1.2 per cent were rejected on account of defects of construction, 0.15 per cent because of too great difficulty in throwing back index, and 0.6 per cent on account of retreating of index; 0.7 per cent were received broken; 0.15 per cent were broken in testing; and 3.1 per cent exceeded the limits of allowable errors.

In addition to the above there were tested in the thermometer laboratories 14 platinum resistance thermometers, 6 thermocouples, the melting point of 11 samples of naphthalene as a basis for custom duties, and the freezing point of 4 fire extinguisher liquids.

Among the calorimetric tests were 2 gas and 1 adiabatic calorimeters. Two hundred and thirty-nine standard heat samples were furnished during the year.

In the high-temperature laboratories there were tested 2 radiation pyrometers, 6 optical pyrometers, 13 pyrometric lamps, 10 base-metal thermocouples, 55 rare-metal thermocouples, 10 pyrometer galvanometers, 5 homogeneity tests of thermocouples, 2 resistance thermometers for high temperatures, 20 melting points of refractories, and 7 special high-temperature tests. In addition there were tested 621 base-metal thermocouples for the fire tests on protected steel building columns now being carried out in Chicago.

The total amount of testing done has increased very considerably over that of any preceding year. This work was done by a somewhat smaller staff and was made possible in part by improved methods and in part at the sacrifice of progress on important technical investigations.

### 3. ELECTRICITY.

[Electromotive force, resistance, current, inductance, capacity, conductivity, insulation, magnetic permeability and hysteresis, and radioactivity, including researches on electrical units and standards, measuring instruments, and methods of measurement, and the cooperation with standardizing committees of technical societies, with testing laboratories, the electrical industries, public-service companies, and public utility commissions, municipalities, and engineers upon problems of electrical standardization, including standards of adequacy and safety of electric service.]

#### Scope of the Electrical Work.

One of the most important functions of the Bureau with respect to electricity and allied subjects is the establishment and maintenance of the fundamental standards upon which all measurements

in these fields are based, including cooperation with similar institutions in other countries so as to secure international uniformity. This includes the intercomparison of standards and extensive research in methods of measurement and the development and improvement of subsidiary and derived standards. These standards are utilized and the results of the researches are immediately applied in the testing of reference standards and instruments for manufacturers, testing laboratories, universities, research institutions, electric utilities, utility commissions, engineering and other interests, and various agencies of the Government.

The testing of electrical instruments and apparatus is of two main classes. First, there is the standardization of reference standards and precision instruments for manufacturing and other institutions which themselves make or standardize instruments for commercial use or which conduct research work. It is through the work of such institutions that the measurements made in practice are referred back to the standards of the Bureau. Second, a limited amount of testing of commercial electrical measuring instruments, radio and photometric apparatus, magnetic materials, etc., is done, chiefly for the purpose of keeping the Bureau in touch with the needs of the industries, of developing methods, and of improving types. The greater portion of this testing is done for the Government services, both for obtaining information to be used in formulating specifications, and for the testing of samples of deliveries of materials purchased upon specifications.

The research work has mainly to do with methods of measurement, the determination of the electric and magnetic properties of materials, and the development of those phases of engineering science in which measurement plays an important rôle. Electrical, radio, and illuminating engineering interests are all served by these investigations. The Bureau also renders important service, both directly and indirectly, to manufacturing and other industries. Some of this investigational work is on the more fundamental aspects of the principles involved, so that the results may be applicable to a class of problems, rather than being limited to the one specific problem under investigation. The work in measurement of lights of different colors, the correlations of magnetic and mechanical properties of iron and steel, and study of galvanometers are examples.

The research work in radio communication, magnetism, radio activity, and photometry is along lines quite similar to that in the more purely electrical measurements. Standards have been and are being developed, methods of measurement are being improved, and important special problems of significance to the industries and in a number of cases of particular importance to the Government, are being investigated. Specific examples of the projects in hand during the past year are given in the sections below.

#### **Relation of the Electrical Work to the Military Services.**

Toward the end of the fiscal year there was a very great increase in the number of electrical investigations of a military character. Most of these investigations are made at the request of the War and Navy Departments, and are in general of a confidential character. The special fund granted to the Bureau by Congress toward the end of the fiscal year for military investigations has made it possible

to add a considerable number of scientific experts and assistants and greatly to increase the work carried on. A large portion of this work is of direct and immediate military value, and much of it will be of permanent scientific value apart from its military usefulness.

### **Silver Voltmeter.**

The final voltmeter paper mentioned in the annual report of last year has now been published as Scientific Paper No. 285. This paper summarizes the Bureau's investigations on the silver voltmeter, which is the primary standard for the measurement of electric current; it also contains the specifications for the voltmeter, which the Bureau has proposed for international adoption, and a bibliography of the subject. It has not been possible during the past year to make further progress toward the adoption of specifications by international agreement.

### **Standard Cell Work.**

Some further work has been done on the Weston normal cell, especially in regard to the methods of efficiently washing mercurous sulphate, which material is the chief source of variation in the cell.

In connection with an investigation relating to the cause of the cracking of Clark cells and the best method of preventing the same, a number of cells of this type were set up, blanks being employed in which the platinum terminals of the zinc limbs were subjected to the action of zinc amalgam before being sealed into the cell wall. Although nearly a year old, none of the cells are cracked. A number of portable unsaturated Weston cells have been made, primarily with a view to insure to the Government an adequate supply for emergency use.

### **Investigation of Inductance Coils.**

The research on the inductance and resistance of standard coils at different frequencies has been continued. A careful study has been made of the factors which cause the inductance of a coil to decrease and the resistance to increase with increasing frequency of current. The most important of these are (1) electrostatic capacity between the windings, (2) energy loss in the insulating material caused by dielectric hysteresis, (3) skin effect in the conductors, and (4) eddy currents in neighboring masses of metal. The effect of all of these can be reduced by proper design.

A large number of coils have been constructed and measurements made to determine the change of resistance and inductance with frequency. Methods have been devised for determining the effect of each of the factors enumerated above on these coils. The experimental determination of the skin effect has been found most difficult. In order to check the experimental values on skin effect theoretical formulas are needed. At present the only satisfactory formulas are those which apply to a straight wire. By means of a new method other formulas are being developed.

### **Study of the Electromagnet Moving-Coil Galvanometer.**

The study of the electromagnet moving-coil galvanometer for use in alternating current measurements has been completed and the results published. (See Scientific Paper No. 297.) These instru-

ments are similar to the moving-coil galvanometer except that use is made of the magnetic field of an electromagnet instead of the field of a permanent magnet. The electromagnet is excited from a separate source with alternating current of the same frequency as the current to be detected or measured. A steady deflection approximately proportional to the current is produced and the motion can be made deadbeat by use of the proper external resistance. Instruments with sensitivities comparable with those for the best moving-coil galvanometers for direct current have been constructed.

#### **A. C.-D. C. Comparator.**

Precise alternating-current measurements are usually made with an electrodynamicometer which is calibrated by reference to direct current standards. An instrument has been devised by means of which reference is made directly to direct current. This consists of an electrodynamicometer whose two fixed and two moving coils are connected to form a balanced Wheatstone bridge. Both the alternating and the direct current pass through the same coils at the same time in such a manner that there is no resulting torque when the effective values of the currents are equal. A comparator of this kind has been subjected to a variety of tests, and the performance is such as to indicate an accuracy better than 0.01 per cent. This comparator can be used to measure currents up to 0.2 ampere directly, and, by the use of standard alternating-current resistances and standard current and potential transformers, voltages and larger currents can be measured.

#### **Bridge for Testing Precision Resistance Standards.**

A resistance measuring bridge, designated especially to meet the Bureau's needs in the accurate comparison and testing of precision resistance standards, has been constructed in the instrument shop and laboratory. It has been thoroughly tested and found to be highly satisfactory. In its design special attention was directed to shielding and thermostatic control of the temperature of the containing oil bath in order to obtain the highest precision attainable. Its large range and convenience of operation permit the comparison of resistance standards to be made with a minimum expenditure of time and energy. A publication is in progress describing the bridge and the methods used in comparing standards.

#### **Electrically Operated Tuning Fork for Time Measurements.**

This device, which has been in use in meter testing for about five years, reads directly to 0.05 second. An electrically operated tuning fork having a period of 0.05 second closes a contact which controls an electromagnetic counting device. By using a key in this circuit the arrangement acts as a stop watch. Special care has to be used to drive the fork at a uniform rate. This has now been accomplished by operating it directly from a chronometer circuit. With slight modification it has been found feasible to use commercial "cycle counters" in place of the special counters previously used. It has also been found that the method can be used with a fork having a frequency of 100, thus reading to 0.01 second. Several meter-testing laboratories have installed duplicates of the Bureau apparatus.

### **Instrument Transformers.**

The accurate testing of instrument transformers is of increasing importance on account of their use in measuring electric energy, especially where it is sold in large quantities or at high voltages. Some of the State public utility commissions now require the periodic testing of all instrument transformers used in the sale of electric energy. For precision laboratory work, the potentiometer method with a vibration galvanometer as detector, has been used for several years. For voltage transformer testing, precision card-wound resistances have now been installed, aggregating 500,000 ohms, which enables direct measurements to be made up to 30,000 volts. A similar and equal resistance used as a protecting guard wire eliminates leakage and errors from capacity currents to earth.

A very considerable amount of assistance has been given to some of the State commissions and to the larger central stations and manufacturers of apparatus in equipping their laboratories for the testing of instrument transformers. In some cases simplified apparatus for using the precision potentiometer method is being installed, and in other cases methods devised at the Bureau for readier adaptation to commercial use have been used.

### **New Method of Testing Current Transformers.**

A new method of testing current transformers, particularly adapted to central-station conditions, has been developed, and the results are now ready for publication. The same current is passed through the primaries of the transformer under test and of a standard transformer whose ratio and phase angle are known. The secondaries are connected in series, aiding, and the vector difference between the secondary currents flows in an auxiliary circuit and is measured directly. Either a null or a deflection method may be used, and the sensitivity is sufficient to permit the use of portable instruments.

### **Remote Control System for Motor Generators.**

The somewhat elaborate system of remote control of the special motor-generator sets has proved to be very satisfactory, and a description of it has been published during the year. (See Scientific Paper No. 291.) The system includes five motor-generator sets, and is permanently wired to nine laboratory rooms, so that by plugging in a special jack one may have complete control of the speed and voltages of the set. The phase relation between voltages is included, and in some cases rheostats for the control of auxiliary direct current and voltage also.

### **Electrolytic Cleaning of Silver.**

At the request of the Department of Agriculture, the Bureau undertook an investigation of the electrolytic reduction of silver sulphide with particular reference to household methods of cleaning silverware by this process. This investigation has been interrupted by more urgent work of a military character, but will be resumed as soon as possible. As an outgrowth of this work, a process was discovered for preparing silver sulphide in a metallic form.

### Electrical Properties of Silver Sulphide.

Silver sulphide may be prepared in the form of short wires and thin strips like a metal. The wire, which must be drawn hot, has been found to conduct electricity like a metal of high resistivity and practically zero temperature coefficient. The strip of sulphide rolled at room temperature has a large temperature coefficient and shows both metallic and electrolytic conduction at the same time. It has a volt-ampere curve characteristic of a pyro-electric conductor. The resistance of these strips has been examined with both alternating and direct current with the result that the alternating-current resistance was nearly always found to be higher than that with the direct current, and the passage of a small alternating current of a frequency as low as 60 cycles increased temporarily the resistance of the sulphide while a small direct current produced the opposite effect. The results of this investigation are now in progress.

### Methods of Testing Transformer Oils.

In cooperation with a committee of the American Society for Testing Materials, a comparative study is being made of disk and sphere spark gaps for testing the dielectric strength of transformer oils. A carefully prepared schedule of tests on different gaps and different spacings is being carried out in four different laboratories. It is expected that data will be obtained which will permit results obtained on one form of gap to be interpreted in terms of other forms of gaps, or possibly a uniform method of testing may be agreed upon.

### Radio Service to the Government.

Cooperative work with other departments and bureaus of the Government has continued during the past year as heretofore. The lighthouse tender *Orchid* and the Coast Survey steamers *Isis* and *Surveyor* were equipped during the year with complete radio outfits designed and constructed by the Bureau for the special service required. At the request of the Bureau of Navigation, an investigation of radio interference in the vicinity of Boston was made.

The Bureau was represented on the interdepartmental committee to consider new radio legislation and took an active part in the discussion and drafting of the bill which was presented to the committee for consideration.

Additional men and funds will enable the laboratory to expedite the work on military problems and to make the laboratory more efficient in its cooperation with the military departments of the Government. Radio signaling is playing an extremely important part in the war, and the radio laboratory staff is taking an active part in the development and improvement of radio apparatus for military purposes and is endeavoring to make the work of the laboratory as useful as possible.

### Fog Signaling.

Practical tests of the radio fog-signaling apparatus and radio-direction finder developed by the Bureau were made at the Navesink Light Station. These tests were very successful and proved conclusively that the use of radio signaling for this purpose is a valu-

able and effective means of promoting safety at sea. A board or committee representing the Navy and Commerce Departments has been created for the purpose of considering and recommending matters relating to the immediate equipment of several light stations with fog-signaling devices. The Bureau will shortly equip the Navesink Light Station with a permanent installation.

#### **Radio Direction Finder.**

Considerable testing and designing has been done during the past year in connection with the direction-finding apparatus with the view of improving its usefulness and adapting it to various practical purposes, particularly those of military importance. A large number of equipments have been manufactured and put into actual use.

#### **Radio Instruments and Measurements.**

In connection with the testing of radio instruments and equipment, studies have been made of the methods of measurement at radio frequencies. These studies continue in progress, and include measurements of wave length, inductance, capacity, resistance, and current over wide ranges at radio frequencies. In order to describe the radio work of the Bureau and to present general information on radio measurements, a circular on the subject is in preparation. In this publication and its subsequent revisions it is planned to give accurate and useful information on radio instruments for the benefit of Government officers, engineers, manufacturers, and operators. Its scope and grade of presentation are intermediate between elementary books for amateurs and the more elaborate treatises on radio theory and practice. It includes descriptions of instruments and methods of measurement, collections of useful formulas and data, a development of the essential theory of high-frequency measurements from simple but precise low-frequency theory, the use of reactance curves in the rapid solution of problems, and a statement of the radio work of the Bureau.

#### **Radio Testing.**

An unusually large amount of radio testing and calibration work has been done during the past year for the Government departments, for commercial concerns, and for amateurs. The facilities of the radio laboratory have been improved as rapidly as possible to meet the increasing demand for radio-frequency measurements, and arrangements are being made to improve still further the methods of testing in order that such work may be done with greater efficiency and rapidity. Standardization and accurate testing become more and more necessary and important as the art of radio communication progresses, and as new devices appear new methods of testing must be developed.

#### **Magnetic Uniformity of Straight Bars.**

The effect of nonuniformity in a specimen on the accuracy of magnetic measurements has been studied and a method has been developed for the determination of the degree of magnetic uniformity of straight bars. (See Scientific Paper No. 295.) A large number of bars have been examined for magnetic uniformity, and



it has been found that only a very few are satisfactory for use as standards. The bars which have been found to be satisfactory have been carefully standardized and are used for calibration and comparison work.

#### **Development of a New Permeameter.**

A new permeameter has been developed which makes possible the rapid determination of normal induction and hysteresis on a single specimen. (See Scientific Paper No. 306.) This permeameter utilizes the principle of the magnetic potentiometer. The magnetizing force is read in terms of the magnetic potential between the ends of the bar by means of the deflection of a ballistic galvanometer connected to an air coil upon reversal of the magnetizing current. The induction is determined in the usual way by means of a test coil surrounding the specimen. The apparatus is accurate within 5 per cent of the magnetizing force necessary to produce a given induction. This accuracy is sufficient for most work on commercial materials.

#### **Calibration of Bismuth Spirals.**

A method has been developed for the calibration of bismuth spirals. This consists of an electromagnet with means of inserting either a standard test coil or a bismuth spiral in the magnetic field between its poles. The strength of field is determined by a ballistic galvanometer deflection when the standard coil is withdrawn from the field.

#### **Study of the Magnetic Susceptibility of Feebly Magnetic Substances.**

A method is being developed for the determination of the magnetic susceptibility of feebly magnetic substances. The susceptibility will be determined by measuring, by means of a sensitive balance, the pull exerted on a sample of standard form due to current in a solenoid surrounding it.

#### **Magnetic Analysis.**

Magnetic analysis consists of the determination of one or more of the magnetic properties of steel which may be taken as criteria of its mechanical properties. The methods of magnetic analysis may be applied to the raw material or to the manufactured product at any stage of its manufacture, provided the test specimen is of suitable form. Even objects whose forms do not permit of accurate magnetic measurements may permit of comparative determinations which, by comparison with a standard, will serve as a basis for judging their quality. The magnetic properties that may be used are normal induction, one or more points on the hysteresis loop, such as residual induction or coercive force, energy loss due to rotary hysteresis, and magnetic leakage under standard conditions. In a general investigation on a particular class of steel, as many of these quantities as possible are determined for a series of different heat or mechanical treatments, together with the corresponding mechanical properties, such as hardness, proportional limit, ductility, ultimate strength, etc.

Magnetic analysis is still in the investigational stage, but considerable progress has already been made. The one-to-one correspond-

ence between the magnetic and mechanical properties has been established and a number of special cases have been investigated. In particular cases a single magnetic value may be sufficient as an index of the mechanical properties. If more information is desired, it may be necessary to make more complete determinations. For example, it has been found that the coercive force is a good index of hardness. For steel of a given chemical composition, the harder piece gives a higher coercive force. In addition, it may be possible to judge of the internal stress from the shape of the normal induction curve. In the course of the general investigation on magnetic analysis, a number of special cases have been studied, including the following:

*One Per Cent Carbon Steel.*—The investigation on 1 per cent carbon steel has been finished. The complete results will be presented in a paper now in course of preparation. A series of sample bars were given different heat treatments and complete normal induction and hysteresis measurements made in the Fahy permeameter and afterwards the mechanical properties were determined. Any difference in mechanical properties was invariably accompanied by a corresponding difference in magnetic properties.

*Steel Rails.*—The investigation on steel rails has been made by means of a permeameter specially designed for the purpose and exploration apparatus consisting of a motor-driven magnetizing solenoid which moves along the rail at a constant rate and carries test coils for determining leakage. A photographic record is made of deflections of the galvanometer connected to test coils. Any deviation from a straight line in this record indicates a nonhomogeneity in the rail. By means of this exploration apparatus records have been obtained clearly showing the strain effects due to gagging, or cold straightening, commonly applied to rails. By means of the permeameter it was possible to distinguish between rails cooled in summer and rails cooled in winter, and therefore likely to be in a state of mechanical strain.

*Ball-Bearing Races.*—An investigation has been started for the development of a shop method for testing the hardness of finished ball-bearing races. Measurements of coercive force have been made by means of an electromagnet with special pole pieces and suitable test coils connected to a ballistic galvanometer. It has been found that the coercive force is a good index of the hardness of the ring. Experiments are also being made on the measurement of rotary hysteresis. This is found by measuring the torque on a ring when placed in a rotating magnetic field. The torque is proportional to the energy loss of rotary hysteresis and increases with the hardness of the ring.

*Small Tools.*—An apparatus has been built especially adapted to the making of magnetic measurements on small tools, such as drills, taps, reamers, gravers, etc. Several sets of measurements of coercive force have been made on drills, reamers, milling tools, and the like, and it has been found that the coercive force gives a good indication of mechanical performance and uniformity of product.

*Steel Cables.*—An extended investigation is planned on steel hoisting cables. It is proposed to study the effects of various factors which may reduce the "factor of safety" of a cable and develop, if possible, a method for determining this reduction of the factor of

safety. It is also hoped to be able to develop a method of judging the quality of a new cable.

*Repeated Stress.*—A study is being made of the effect of repeated stress on the magnetic properties of steel. The stress is applied by means of an electromagnet device similar to an electrically driven tuning fork. The bars are removed from the apparatus at intervals and determinations made of normal induction, residual induction, and coercive force. It is hoped in this way to be able to follow the course of progressive failure and that this may prove to be a useful method for checking design.

#### **Magnetic Compass Investigation.**

At the request of the compass division of the Naval Observatory, the joint Army and Navy Board on Specifications and the Shipping Board, an investigation has been begun on magnetic compasses. The investigation is for the purpose of developing a standard method of testing compasses and the preparation of specifications for the purchase of compasses by the Government. A special form of magnetometer has been devised for the determination of magnetic moment and a rotation test for pivot friction is being investigated. It is expected that several thousand compasses will be tested in the course of the next year.

#### **Increase in the Bureau's Stock of Radium.**

A 49-milligram tube of radium which was loaned by the Bureau of Mines has been of great assistance in the routine testing during the year as well as in the study of the methods of testing. This tube and a second tube containing about 91 milligrams of radium have been permanently transferred by the Bureau of Mines to the Bureau of Standards, and constitute a very valuable addition to the Bureau's equipment for radio-activity measurements. The radium contained in these two tubes has a market value of about \$14,000.

#### **Radium Emanation.**

The study of apparatus for impregnating water with radium emanation has been continued, and the radium emanation contents of a few therapeutic solutions have been determined. Radium solutions to serve as standards in the measurement of radium emanation have been supplied to scientific investigators desiring them.

#### **Radium Luminous Preparations.**

Owing to the fact that the luminescence of radium luminous preparations persists for months or years and is not dependent upon a previous exposure to light, such preparations are of great value in the illumination of signs and dials that have to be read in the dark. They are largely used on instruments employed in aviation and for other military uses.

The Bureau began the investigation of these preparations during the year, and now has under study 50 specimens obtained from various sources. A photometer for the measurement of the brightness of these preparations has been constructed and described, and apparatus for the measurement of the material after it has been applied and for the routine testing of prepared dials is being designed.

The manufacturers and users of these materials are cooperating with the Bureau in this work. Conferences concerning the military use of these materials have been had with members of the Aviation Corps and of the French Scientific Commission. Preliminary reports of the work have been furnished on request to the National Advisory Council for Aeronautics and to the Signal Corps.

#### Radium Testing.

The amount of radium measured during the year was about 50 per cent greater than that measured last year. It amounted to a little over 6.6 grams, which, at \$100 per milligram, is worth about \$660,000. This radium was contained in 288 preparations, submitted by 24 individuals or firms, and was distributed to over 79 individuals and institutions. Of these preparations, 1 was for Porto Rico, 2 for the Philippine Islands, 6 for Argentina, 18 for Spain, 10 for Russia, and 2 for Japan. A number of the preparations were shipped to distributing companies; in such cases the Bureau has no information regarding the ultimate destination of the material.

#### X-Ray Testing.

The Bureau is installing an equipment for X-ray testing, and it is expected that this testing will be under way by August, 1917. The Bureau has been requested from time to time, for the past several years, to undertake such work, but until now it has been unable to do so on account of a lack of funds. The work will include not only the testing of apparatus and materials employed in the surgical and therapeutic applications of X-rays, but also the use of X-rays in various other problems of military value.

#### Improved Methods of Measurement in Photometry.

In continuation of the work in this line reported last year, attention has been given to the further development of methods of measurement applicable to the new types of electric lamps which are coming into very extensive use.

Little new experimental work has been done in the past year on account of the difficulties arising from the fact that these lamps give light differing in color from that of the standards. However, the methods of meeting these difficulties and of correction for the peculiarities of vision of the individual observer have been tried out in a considerable variety of practical problems. This experience has confirmed the conclusion that the flicker photometer, used under proper conditions, provides a fairly satisfactory means of measuring lights of every color. Consequently, the Bureau has submitted to the Illuminating Engineering Society a proposal to adopt the flicker method as the standard one for measuring the brightness of all lights which differ in color from the fundamental standards. A considerable part of the work on which this proposal is based has been published in Scientific Paper No. 299.

In rating and testing ordinary incandescent lamps, it has been customary to measure only the mean horizontal candlepower, which is obtained by rotating the lamps while they are being measured. This procedure can not be used with the new gas-filled lamps, because the rotation changes the convection currents in the gas and

consequently affects the candlepower. Moreover, these lamps have filaments of irregular form, and the horizontal candlepower does not bear any definite relation to the total amount of light produced. Consequently, the only instrument suitable for measuring these lamps is the integrating sphere, which shows by one measurement the total amount of light sent out by a lamp in all directions. The 90-inch reinforced concrete sphere built at the Bureau has proved very satisfactory. During the year attention has been given to the conditions of operation which may affect such measurements, and a paper incorporating the results, together with a description of this sphere, has been nearly completed.

Spheres have come into regular use in many lamp factories, and one of the great practical difficulties has been to obtain a strictly colorless material for coating the inner surface. Much time has been spent in testing commercial paints and experimental mixtures for this purpose; this work is not yet completed, but the use of barium sulphate with a cellulose binder made up in proper proportions promises to be a solution for the difficulty.

In connection with the above investigation, many measurements of the reflection factor of materials have been made, and for such measurements new methods have been devised which it is hoped can be developed further during the coming year.

By using the flicker method to overcome the difficulties of color, and the sphere for comparison of spherical candlepowers of vacuum and gas-filled standards, sets of secondary standards of the gas-filled type have been established and the candlepowers repeatedly checked by independent comparison with the Bureau's standards of horizontal candlepower. The performance of these gas-filled standards has so far been very good, and similar standards have been furnished to a number of other laboratories and to lamp factories.

#### **Life Testing of Gas-Filled Lamps.**

The life testing of gas-filled lamps was begun during the year. These lamps have peculiarities which necessitate special methods in the life test as well as in the measurement of candlepower. Vacuum lamps are usually tested at voltages considerably higher than normal, thus shortening their actual life in order to get results more quickly and to reduce the cost of the testing. The proportion in which the life is reduced by a given increase of efficiency has been carefully determined, so that the normal life can be quite accurately computed from such "forced tests." In the case of the gas-filled lamps, however, this method can not be used because at the higher temperature the filaments are likely to sag and open up the spirals in which they are formed. This lowers the temperature and, consequently, the lamp operates at lower efficiency and has a life very different from what it would have if the filament retained its normal shape. It is therefore necessary to life test these lamps at their normal operating efficiency, although this makes the test extend over a long time.

#### **Investigation on Flames and Gas Mantle Lamps.**

A large amount of work has been done on gas lamps. The photometric methods developed for the electric lamps are applicable also to gas lamps; the difficulties to be met are not in the mere measure-

ment of the light produced, but rather in the adjustment and performance of the lamps themselves. Economic conditions are forcing a change in the quality of gas supplied in most American cities, and the proper readjustment of standards of quality is an urgent problem which can not be solved without knowledge of the efficiency with which different gases can be used. As a part of a general investigation of this subject by the public utility staff of the Bureau, an extensive study has been made of the effects of variation of heating value and composition of gas on the candlepower and efficiency of mantle lamps at various pressures and rates of consumption. The results of this investigation are now in course of preparation for publication.

In order to compare measurements made on mantle lamps at different times and places, it is necessary to know the effects of atmospheric conditions on the candlepower; these effects have been determined, and the results together with similar determinations on some flame lamps have been incorporated in a scientific paper which is nearly ready for publication. A comparison of the results obtained by the Bureau on the pentane lamp with those obtained in England has shown that the outstanding differences with regard to correction factors are undoubtedly due to the existence of a temperature coefficient, which is, however, small as suggested in previous papers of the Bureau.

#### Tests of Miscellaneous Illuminants.

As an outcome of the tests made last year on self-lighting emergency lights for life buoys, the Steamboat-Inspection Service adopted new specifications for such lights, and this Bureau has been called upon to test a number of them to determine whether they fulfilled those specifications.

A number of experimental searchlights intended for use on airplanes were tested for the Navy Department, and suggestions were made regarding the construction and operation of special lamps for such lights.

A comparative test of 12 types of hand lanterns for the United States Coast Guard was made as a basis for specifications, which were drawn up to cover the purchase of lanterns by the service.

Measurements were made on a large number of street-series lamps from various municipal lighting plants, to obtain information on the performance in actual service of the newer types of lamps.

Measurements have also been made on all the common sizes of street-series lamps to determine the variation of candlepower with current; in these measurements lamps from several different factories have been included.

#### Inspection and Life-Test of Lamps for the Government.

During the year there were inspected for the various Government departments nearly two million lamps; of these about five hundred thousand were carbon. Rejections on account of various defects were unusually large, amounting to about 10 per cent of the tungsten and to about 25 per cent of the carbon. Sample lamps amounting to 2,451 (2,076 tungsten and 375 carbon) were life tested. In comparison with recent years the results of the tests for the year show, in respect

to both carbon and tungsten lamps, a depreciation in quality, not only in life, but also in the mechanical features of the lamps. This depreciation is attributed by the manufacturers to the unusual condition of increased production, shortage of competent labor, difficulty in obtaining satisfactory raw materials, etc.

Realizing that these conditions were beyond the control of the manufacturers, the Government lowered the efficiency requirements of the specification in order that the manufacturers might be able to meet them.

### Electrical Testing.

*Instruments.*—Tests of electrical instruments for the public during the year included the following: Four voltmeters, 2 ammeters, 14 wattmeters, 11 watthour meters, 11 voltage transformers, 22 current transformers, 1 inductance coil, 8 condensers, 8 wave meters, 17 decimeters, 1 buzzer, 7 air condensers, 49 mica condensers, 78 resistance standards, 1 resistance box, 9 resistance bridges, 3 potentiometers, 59 standard cells, 50 incandescent lamps life tested, 44 incandescent standards furnished, 41 incandescent standards tested, one portable photometer, 6 pentane lamps, 15 street-series lamps, 3 gas mantle lamps, 4 lamps for certain colors of light, 77 spherical-candlepower standards, 1 diffusing globe, and 2 lighting fixtures.

Tests of electrical instruments made for the Government during the year included the following: Eleven voltmeters, 17 ammeters, 2 wattmeters, 6 watthour meters, 2 voltage transformers, 13 current transformers, 93 dry cells, 50 electrical fans, 99 inductance coils, 9 condensers, 14 decimeters, 1 resistance bridge, 2 potentiometers, 68 standard cells, 2 air condensers, 5 mica condensers, 65 airplane compasses, 489,821 carbon lamps inspected, 1,292,223 tungsten lamps inspected, 2,451 incandescent lamps life tested, 14 incandescent standards furnished, 30 incandescent standards tested, 48 reflectors, 3 searchlight reflectors, 9 life-buoy lights, 2 portable photometers, 6 electrical standard lamps, and 2 acetylene standard lamps.

*Materials.*—Materials tested for the public during the year, involving electrical measurements, included the following: Seventy conductivity samples, 14 inductance tests, 21 iron samples for normal induction, 4 hysteresis samples, 26 core-loss samples, 3 miscellaneous magnetism tests, 198 tubes of radium, 3 emanation specimens, 1 standard radium solution, 6 activators, 2 radio-active waters, 50 luminous materials, 3 X-ray tests of powders.

Materials tested for the Government during the past year, involving electrical measurements, included the following: Fifty transformer oils, 275 rubber gloves, 31 samples of insulating tape, 11 battery renewals, 11 fuses, 23 miscellaneous insulation tests, 480 conductivity samples, 10 inductance tests, 2 hysteresis samples, 1 core-loss sample, 10 permanent magnets, 25 tubes of radium, 17 samples of kerosene oil, and one sample of signal oil.

### Information Furnished on Electrical Subjects.

A large part of the work connected with the various investigations and tests consists of correspondence, in which scientific and technical information is furnished by the Bureau. Information is also frequently furnished as a result of particular requests. Assistance and

advice have thus been rendered on electrical subjects to a number of Government departments, to various scientific institutions, manufacturers, public utilities, universities, and engineers.

The Bureau cooperated with various electrical engineering, technical and scientific societies, and is represented on many of their technical committees, particularly where electrical standardization is involved, such, for example, as the American Institute of Electrical Engineers, the American Society for Testing Materials, and similar bodies.

Assistance has been rendered the Post Office Department and the Department of Justice in several legal cases, involving questions of physics and engineering, and in which fraud was charged. Sometimes the cases lead to ordinary court processes, and sometimes to postal fraud-order procedures. In some cases a considerable amount of work was involved in investigating the various technical factors involved.

Tables and other data were furnished for a new reprint of the Smithsonian physical tables. An elaborate handbook on electrical wire was reviewed and corrected for a large commercial company. Information was furnished on the available sets of tables for mathematical calculations. As a result of a request from the War Department, the Signal Corps copper-wire specifications were carefully studied and information supplied with a view to harmonizing them with commercial conditions.

There has been a marked increase during the past year in the number of requests for specifications and detailed information on the setting up of standard cells. Many users of cells have been faced with the necessity of making their own cells because of the increased demand and a shortage in the supply.

#### **New Fee Circular.**

The seventh edition of Circular No. 6, Fees for Electric, Magnetic, and Photometric Testing, has been prepared and issued. The principal new features of the edition are a rearrangement of the instrument schedules; the addition of considerable explanatory matter regarding the testing of instruments, meters, transformers, and resistance apparatus; and the provision of a separate section for radio apparatus.

#### **Publications on Electric Units and Standards.**

Two publications have been issued on the general subject of the fundamental electric and magnetic units and standards. The available information on this subject has hitherto been scattered over an extensive literature. Circular No. 60, Electric Units and Standards, gives a comprehensive and up-to-date treatment of the various units and the standards by means of which the units are maintained. This compendium will be of use to teachers and students, to testing laboratories, and to electrical engineers. It takes the place of certain previous publications of the Bureau dealing with special aspects of the subject. It includes a history of the units and the evolution of the definitions upon which the laws on electrical standards are based. The present status of the fundamental electrical standards is described, and the laws on electrical units in the various countries of the



world are given. The laws of the different countries are in substantial agreement, and the various national bureaus of standards co-operate in maintaining the fundamental standards. The circular gives conversion factors, by means of which measurements may be expressed in any desired unit, and also gives a selected bibliography of previous writings on electrical and magnetic units and standards. In connection with the preparation of this circular, a critical study was made of the various systems of units which have been proposed from time to time as having noteworthy advantages over the commonly used system. The results of this study were published in Scientific Paper No. 292, International System of Electric Units and Standards. Diverse units are used to some extent at the present time, and are a source of confusion to the student and to the engineer. As a result of comparing all of these systems, it appears doubtful whether any of the proposed systems of electrical units is materially superior even in its theoretical aspects to the international system of units in general use, and it is concluded that there would be no compensating advantages to justify the trouble and confusion which would attend a change of units.

#### Public Utility Investigations.

A large and important field of work, including more of engineering and field work than most of the electrical work so far described, is concerned with the various public utilities, particularly the electric light and power, gas, street railway, and telephone companies. The work includes (1) scientific and engineering research, (2) the study of public-relations questions, (3) the preparations of specifications regarding the quality of public-utility service, (4) methods of testing and inspection employed by municipalities and commissions, (5) safety rules for use by the utility companies to safeguard their employees and the public, and (6) the collection and distribution of information by published papers and through correspondence.

This work is a natural outgrowth of the research and testing work done by the Bureau of Standards for the public-utility companies for several years. The testing of electrical instruments and meters, of gas lamps and the standard employed in measuring the candle-power and heating value of gas, the life testing of electric lamps, the testing of instruments used in telephone work, research on electrolysis mitigation, and similar investigations and tests connected with the public utilities have all involved to a greater or less degree questions of standards of service in the various public utilities and hence the Bureau gradually accumulated a considerable amount of information on these questions. Such information on several phases of the work has been collected and published from time to time, and other publications are in preparation. The work in recent years has been considerably enlarged through special appropriations for this purpose.

#### Gas Service Rules.

During the past year the usual amount of work in correspondence and conferences has been given to questions of standards for gas service and of rules in force or proposed for adoption by cities or States. The proposed revision of the rules of the State of Washington and the new rules proposed for the State of Colorado were

both examined and commented on by the Bureau during the year. A report was also rendered after investigation of gas service conditions in Rome, Ga., covering the questions of the needed improvements in the plant and distribution system in order that satisfactory gas service be rendered in that city. This report was rendered at the request of the Georgia Railroad Commission, which has jurisdiction in the matter.

Bureau of Standards Circular No. 32, Standards for Gas Service, has been reprinted in the third edition because of the lack of time for preparation of a fourth edition. The fourth edition is urgently needed in order to bring up to date the compilation of rules and ordinances now in force and also to take account of developments in this field brought about by improvements in gas-making methods, changed economic conditions, and numerous other engineering and economic influences. Particularly it is desired that this circular be supplemented by a publication covering special standards for fuel-gas service. This proposal, which is made to the Bureau by certain representative gas companies, contemplates the adoption of standards based upon novel principles. Particularly it is proposed to charge for gas on the basis of a certain number of cents per million heat units and to eliminate any specific requirements as to the heating value per cubic foot. Extended laboratory investigations as to the relative usefulness of the different gases which might be supplied under such a standard are necessitated by this request for the cooperation of the Bureau; it is also desired by those proposing this new type of standard that the Bureau lend the force of its support to the new system of charging for gas. This could only be done, however, after a careful and rather extended investigation. This investigation is under consideration, but as yet no arrangements have been made to undertake the work.

#### **Standards for Gas Service as Affected by War-Time Conditions.**

The abnormal condition of the labor and coal supply, unusual high prices for raw materials, and the demand for toluol, which can be successfully recovered as a by-product from the city gas supplies, has given unusual importance to questions of standards for gas quality at the present time. At the request of several States and cities, the Bureau has given special attention to these matters, and at the request of the Council of National Defense the Bureau has rendered one preliminary report to it upon the scope and importance of this subject. During the coming months a large amount of time must be devoted to these questions in order to meet the pressing need for information that will permit prompt adjustment of matters where changes are essential or to determine in the other cases whether any change in standard is either expedient or necessary.

#### **Gas Laboratory Methods.**

Continuing the service rendered in past years, the Bureau has furnished information from time to time as to gas-testing methods for cities, State, and company laboratories, by answering correspondence, by inspection of laboratories, and by conference with city and State representatives. As one example of this work, a representative of the Bureau spent a week or 10 days in the laboratory of the city of

Cleveland and made an extended report on the improvements in laboratory apparatus and methods which would be desirable in order to make entirely adequate for local conditions the gas-testing facilities of these laboratories.

### **Relation Between Heating Value of Gas and Its Usefulness.**

An extended series of experiments has been made during the past year to determine the relation between the usefulness of gas for mantle lighting, cooking, water heating, and other purposes, and the heating value of the gas. This work was conducted at the time primarily to answer the question addressed to the Bureau jointly by the city of Chicago and the Peoples Gas Light & Coke Co. of that city, namely, what is the relative usefulness of gas of 565 Btu per cubic foot and gas of 22 candlepower. The investigation included a determination of the influence of pressure, pressure variation, rate of gas burning, adjustment of appliances, heating value and composition of the gas, and variation of heating value upon the efficiency with which the gas could be utilized by the customer. As a result of this investigation a report was rendered to the city and gas company of Chicago, answering specifically the questions which they had asked. It is concluded that if the appliances are properly adjusted and the quality of the gas is uniform the heating value is a direct measure of the usefulness of the gas for ordinary purposes within the range investigated. The principal advantage or disadvantage of one quality of gas as compared with another is therefore the result only of the greater ease of adjustment or lesser likelihood of getting out of adjustment of appliances when using one kind of gas than another. The Bureau, for purposes of its report, estimated the importance of this factor for the particular gas in question.

The further work contemplated in connection with the investigation of the advantage of modified fuel-gas standards, as above described, will also develop further information along these lines. Especially it is desired to study the relative usefulness of different gases such as might be made commercially if the variable heat unit standard were adopted. These would be particularly gases of low heating value as compared with the present commercial supplies, and very little information is thus far available to determine whether or not they could be used with entire satisfaction for various applications of gas. The practicability of the proposed standards depends largely upon the result of this investigation and it is, therefore, of great importance that this work be pressed by the Bureau in the near future in order that the very great advantages claimed for the new standard may be made possible in case it proves practicable to adopt such modified requirements.

### **Inspections of Gas-Mantle Lighting.**

In connection with the investigations thus far conducted an extended series of inspections of gas mantle lamps in actual service have been made in order to determine as far as is possible the relation between laboratory experiments and practical conditions. In

this work about 10,000 mantle installations have been inspected in 10 large cities, and the results have been summarized in a report now in press entitled "Gas-Mantle Lighting Conditions in Ten Large Cities in the United States." This report also develops information of great interest as bearing upon the advantages to the customer of regular maintenance service by gas companies. It is demonstrated that lamps not so maintained regularly are much more likely to be out of order than lamps regularly cared for by the company.

### **Proposed National Gas Safety Code.**

During the past year the proposed "National gas safety code" has received considerable attention by the gas engineering staff, but not as much progress has been made as was anticipated because of the necessity for interrupting this work in order to carry out the investigation, already referred to, on the subject of the relative usefulness of different qualities of gas. The part relating to gas fitting has been submitted to representative architects and engineers, and their comments have been received. The parts dealing with the manufacture and distribution of gas and the design of gas appliances are nearly completed in manuscript form but have not yet been submitted to the advisory engineers. Information for the users of gas has been substantially covered in the gas section of the circular on Safety in the Household, and the completion of this part of the code will be a comparatively simple matter. It has not been possible as yet to undertake the remaining parts of the code.

### **Economic Importance of the National Gas Safety Code.**

The Bureau of Standards in carrying out this investigation desires to serve as a national coordinating agency to the end that the resulting code will be acceptable and adequate, not only from the standpoint of the user of gas but also of the casualty and fire-insurance interests, the gas companies and their employees, and the gas appliance, manufacturing, and selling interests.

The need and value of such a code is so great that the various national organizations dealing with subjects covered by the code have appointed special committees and expert representatives to assist in the investigation. The following organizations are now cooperating in this work: The American Gas Institute, the National Commercial Gas Association, the Natural Gas Association of America, the National Fire Protection Association, the American Institute of Architects, the National Safety Council, and the National Association of Master Plumbers. In order that the Bureau may have the fullest information on every detail of the subjects discussed, the American Gas Institute has appointed 12 committees, 4 in each of the three principal sections of the country—East, Middle West, and Far West. One committee in each district is intrusted with the work bearing upon one of the principal phases of the investigation.

It has been estimated that avoidable accidents due to ignorance, carelessness, or faulty installation result in the loss each year of hundreds of lives and the destruction of property of large aggregate value. It may reasonably be expected that many of these losses will

be eliminated when the code has been completed and adopted throughout the country, both because of the official enforcement of the code and because of its educational value to gas fitters, appliance manufacturers, utility operators, and the general public.

The code will also serve to unify practice in gas installations and gas-company operation work throughout the country, and it is anticipated that much needed reforms will result. This uniformity of practice will not only tend to greater safety but will also contribute to higher efficiency. In many cases differences between the insurance and gas-company officials can be settled by reference to the code and thus more harmonious cooperation of the two parties can be expected. Already several important instances have been referred to the Bureau for consideration with a view to the settlement of differences in insurance-inspection practices or questions as to the magnitude of the fire hazard in certain types of gas installations. In this field the services of a recognized national authority are essential in order to standardize the practices and to make available to all the experiences obtained in the various localities. The effort of the Bureau has therefore been directed not only to the preparation of the code, but to the collection of such information as will enable it to serve as a national coordinating agency in this field.

#### **Electrical Service Rules.**

For several years the Bureau has been studying the questions of specifications for electric light and power service, and the requirements that should be made by municipalities or by State public-service commissions of the public-utility corporations engaged in furnishing such service. This study was published early in the fiscal year as Bureau Circular No. 56, Standards for Electric Service.

The demand for this circular has been large, and it is gratifying to note that the rules, specifications, and ordinances proposed have been made the basis for State rules and city ordinances in the instances named below. During the three years that the circular was in preparation, representatives of the Bureau attended hearings in various States upon invitation by the commissions interested, and assistance was given to the commissions in Connecticut, District of Columbia, Maryland, Missouri, New Hampshire, Oregon, and West Virginia in drafting their rules for electric service. In a number of the States where no public-utility commission is established, city authorities have been assisted in drafting ordinances on the regulation of electric and gas service. Louisville, Ky., has an ordinance based on the proposals made in Circulars Nos. 32 and 56. Since the Circular No. 56 has been issued, the proposed State rules, with necessary local changes, have been adopted by the Public Service Commission of Colorado, and are being made the basis of the revision of rules now under consideration in Illinois, New York, and Washington. The Public Utilities Commission of the District of Columbia has adopted the Bureau's proposed specifications for the acceptance of types of electric meters, as given in Circular No. 56, without change.

In addition to the proposed State rules and specifications for acceptance of types of meters, the circular contains three regulatory ordinances, suggested for cities of various sizes, descriptions of commission standardizing laboratories, and a complete and exhaustive

digest of all State rules heretofore adopted and ordinances now in force in various cities. A revised edition is now in course of preparation, and the Bureau again wishes to acknowledge the continued cordial cooperation of public-service commissions, municipalities, and public-service corporations, the National Electric Light Association, and the Association of Edison Illuminating Companies.

### Street-Lighting Service.

For a year or more the Bureau has been engaged in a study of street lighting in its technical and engineering aspects, with particular reference to the requirements that should be put into contracts between municipalities and public-service corporations for furnishing gas and electric street lighting. A number of municipal and private plants have been inspected, photometric measurements made, and conferences had with managers and illuminating engineers.

The Bureau has been receiving the hearty cooperation of municipalities and lighting companies, but the war has necessitated a discontinuance of much of the work on the part of the Bureau, and public-utility companies also find themselves unable to cooperate as fully as they would like to do. A special committee of the Edison Association of Illuminating Companies on street lighting will resume its cooperation with the Bureau at a later date.

The manuscript of a circular on "Standards for street-lighting service" is partly completed in a preliminary form. The scope and completeness of this study of street lighting are indicated by the following proposed table of contents:

1. The purpose and problem of street lighting.
2. The measurement and distribution of light and illumination in street lighting.
3. Lamps and accessories used in street lighting.
4. General principles governing the design of a street-lighting system.
5. Description of typical street-lighting systems.
6. The economics of street-lighting systems.
7. Discussion of contracts for street-lighting service.
8. Suggested street-lighting contracts.
9. Statistical appendixes.

As in the case of Standards for Electric Service the Bureau seeks, while representing the public interest, to get the utilities' point of view also, and the study of street lighting will not be published until full discussion and cooperation can be had from public-utility corporations, technical societies, municipalities, and other interested parties.

### National Electrical Safety Code.

The Bureau has been engaged for four years in a study of the life hazard in electrical practice and in the preparation of the National Electrical Safety Code. In this work it has had the cooperation and assistance of a large number of engineers, many of whom are connected with the electrical operating and manufacturing companies, others being engineers and inspectors of State commissions and municipalities. The various national associations connected with the electrical industry have also cooperated effectively in this work. The importance of having a national code uniform in all the States

is realized to be quite as great for accident-prevention rules as for fire-prevention rules, and the advantage of having such a code prepared and presented by a national agency that can study the subject thoroughly and consult all the interests affected is obvious.

The safety code consists of four principal parts, as follows:

1. Rules for the installation and maintenance of machinery, switchboards, and wire in central stations and substations.

2. Rules for the construction and maintenance of overhead and underground lines for the transmission and distribution of electrical energy and intelligence.

3. Rules for the installation and maintenance of electrical apparatus and wiring in factories, residences, and wherever electricity is utilized for light, heat, or power.

4. Rules to be observed by employees in working on or near electrical machines or lines.

This code does not include the matter covered by the Underwriters' Fire Code, but is parallel to the latter and consistent with it.

The code is intended to be adopted by State industrial and public-service commissions and municipalities, and to be complied with by public-service and industrial corporations. It is also intended to be adopted voluntarily by electrical interests when the code has not been adopted by any administrative body having jurisdiction in their district.

The Bureau's thorough study of the diverse conditions under which electricity is generated, distributed, and utilized, and of the effect of the rules on operating and construction costs has secured a code which involves no unreasonable expense, but in general assures an adequate measure of safety and a useful standardization of practice. The large number of conferences held in all parts of the country for discussion of preliminary drafts of the code aided largely in its development to the point where it was possible to recommend it for general use throughout the country. The varying conditions in different geographical sections, and in thickly and thinly populated districts, have been given careful attention.

The code was published originally in two installments for examination and criticism; the operating rules were published in August, 1914, and revised in May, 1915; the construction rules were published in April, 1915. Both operating and construction rules, again revised after a general conference of all interests in Chicago in the summer of 1916, have now been combined in a single volume which was published in November, 1916, with a recommendation for actual field trial. It has been the intent of the Bureau as well as the desire of all branches of the industry, that the rules should be revised and extended as experience in their use and the progress of the electrical industry shows revision and amplification to be to the public advantage.

#### **National Electrical Safety Code in Practical Use.**

The electrical safety code has now been adopted in one form or another, in part or in whole, by some 14 State administrative bodies, and is also being used by the inspection departments of many cities and boards of underwriters. It is being utilized as a basis for a merit-rating schedule by the casualty interests, just as the Under-

writers' Fire Code has been used by the fire underwriters for some years. Such schedule rating should result in emphasizing both the merits and demerits of particular installations from the safety standpoint, and tend to reduce accidents by proper financial recognition of each improvement made. The code is also being voluntarily applied by a large number of utilities and industrial concerns in their own practice. It is receiving the general approval of all these interests as rapidly as its usefulness is becoming recognized, and its advantages are seen to be greater than any minor present inconvenience which its introduction may cause. It is becoming generally understood that the stability in electrical practice provided by such a national standard also conduces greatly toward the general economy, the necessity for which is becoming emphasized during this period of national stress.

### Scope and Application of the Electrical Safety Code.

In view of the fact that some 80 State administrative bodies and many cities have electrical departments, it is necessary that the Bureau send engineers frequently to different parts of the country to assist and cooperate with these administrators and other officials who are considering the adoption of the safety code, or as sometimes has occurred, are considering the adoption of other electrical safety rules prepared locally.

To aid in presenting the safety code in cases where conference is not possible with the limited staff of the Bureau, and to assist in explaining the intended application of the code, a publication has been prepared and is about to be issued entitled "The scope and application of the national electrical safety code." In this are included brief summaries of the different parts of the code, reasons for the character of treatment employed, some discussion of the measures taken to secure adequacy and reasonableness, and some recommendations for the method of conducting inspections of installations to secure compliance with the safety-code provisions. The publication also contains descriptions of a number of typical accidents, repetition of which would largely be prevented by observation of the national safety code rules for construction and operation.

### Inspections Under the Electrical Safety Code.

Partly to aid in further revisions of the safety code, and partly to assist in bringing it into actual use, the Bureau is conducting a number of inspections of different electrical systems in order to compare electrical practice in a large number of typical cases with the requirements of the code. These comparisons are demonstrating the general adequacy and reasonableness of the rules and their value in promoting reliability of service as well as safety. Such comparisons have also had the important result of interesting many engineers in the more active application of the safety code.

The three years' preliminary study that was given to the subjects treated in the code, the many public conferences held in all sections of the country, and the immense amount of work done by the engineers who have cooperated with the Bureau, including the representatives of the large number of national and State associations connected with the electrical industry, probably constitute a more



thorough study and discussion than was ever given to a similar set of rules for practice before they were finally promulgated for use. The trial of the code is now proving the great value of this very extended preliminary study, since no important errors or oversights in the safety code have so far been brought to the attention of the Bureau, although a number of points have arisen where minor amendments can be made in a subsequent edition. The rules are proving generally clear and workable. Revisions will, of course, be necessary as experience accumulates and electrical applications increase, and these will be made after full discussion with all the affected interests.

#### **Organizations Cooperating in the Preparation and Revision of the Electrical Safety Code.**

Among the national organizations actively cooperating with the Bureau in the preparation, development, and introduction of the safety code are the American Institute of Electrical Engineers, the American Electric Railway Association, the American Institute of Architects, the American Railway Association, the American Telephone & Telegraph Co., Association of Railway Telegraph Superintendents, the Bureau of Mines, the International Association of Municipal Engineers, the International Brotherhood of Electrical Workers, the National Electric Light Association, the National Fire Protection Association, Postal Telegraph Co., Underwriters' Laboratories, Associated Manufacturers of Electrical Supplies, the National Electrical Contractors Association, the Electric Power Club, Association of Edison Illuminating Companies, Workmen's Compensation Bureau, and the National Safety Council. It is largely through the cooperation of these organizations that the preparation and introduction of the code have been thus far so successful.

#### **Electrical Protection for Household.**

The Bureau has conducted a study of electrical hazards in the household and the means for reducing them to a minimum. The results have been incorporated in an illustrated electrical chapter to the "Household safety" circular, now practically ready for publication. In this study the cooperation and criticisms of lighting utilities and underwriters have been received, and the publication is in popular language, calculated to appeal to the understanding and interest of school children as well as to the intelligent householder.

#### **Special Problems in Overhead Lines and Industrial Installations.**

As an outgrowth of the work of the National Electrical Safety Code, a study of the mechanics of overhead line construction has proven necessary, and extended tests and field measurements have been conducted on wires and supporting structures, the results of which will be brought together later in a publication entitled, "Engineering Data on Overhead Lines." Work on this publication, which will be of use to engineers of utilities, and particularly to engineers of administrators, has been delayed by the limited appropriation for studies of this kind. The advantage of these investigations for promoting the safety of the public and the advantages to the industry in securing greater uniformity of practice are obvious, and the studies along this line are being continued as rapidly as the facilities permit.

A study is being made of the best methods of providing industrial control equipment with guards or otherwise meeting the requirements of the safety code, and manufacturers' associations are heartily cooperating with the Bureau in this work.

### **Electrolysis Problem Among Public Utilities.**

The majority of the street railways of the country are operated on the single overhead-trolley plan, with the electric current flowing into the rails through the car wheels, after it has passed through the car motors. The current then flows back to the generating station or substation by way of the tracks and earth, some of it, however, often flowing through underground gas and water pipes and the lead sheaths of underground telephone and electric-light cables, and sometimes through reinforced concrete structures. The earth conducts electricity by virtue of its moisture and the salts dissolved in it, which render it an electrolyte. Hence, when the electric current flows away from iron pipes or lead-cable sheaths, it carries away iron or lead by electrolytic action, and this in time corrodes the pipes and shortens their useful life and sometimes completely destroys them in a relatively short time. The property damage caused by these earth currents when they are considerable, affects to a greater or less degree all the public utilities.

The trouble is the more serious in places where the soil has a greater conductivity than usual, and where the conductance of the tracks is small in proportion to the current, and the distance the current travels back to the stations is relatively great. Many remedies have been proposed and tried, but no standard practice for the handling of the return current has ever been agreed upon in this country. As the electric railways have been extended and traffic has become heavier, the volume of current handled has increased very greatly, and the resulting destructive effects, which are cumulative with time, have become increasingly evident. In some cases litigation has resulted between the pipe-owning companies suffering damage and the railway companies whose current causes the trouble. But although the courts have considered the question of legal responsibility, these cases did very little to prevent the trouble in an effective and economical manner.

### **Economic Importance of the Electrolysis Problem.**

The subject of electrolysis of underground pipes, cables, and other metal structures is one which has been given more attention in recent years than formerly, but it still does not receive the attention in many quarters that its importance deserves. When one considers the enormous value of the pipe and cable properties buried in the streets of cities and forming in many cases transmission networks between cities throughout the country, and considering further that there are very few water, gas, or lead-cable systems which are not more or less subject at some points to electrolytic damage from stray currents, it is possible to better form a judgment of the practical importance of this subject. The water and gas pipe systems of this country alone have an aggregate value at the present time in excess of a billion of dollars, and in addition to this there is a vast extent of underground lead-cable systems belonging to telephone and elec-

tric power companies and to municipalities. In addition to these vast properties in the earth, a considerable part of which may be more or less subject to electrolytic damage, there are possibilities of trouble in the case of bridge structures, portions of steel frame buildings, and piers, which are occasionally exposed to damage from this source.

While the total losses due to shortening of the life of underground pipes and cables must be considerable, such loss does not by any means represent the total annual damage due directly to electrolysis. It is well known that the annual loss due to leakage of water and gas from distribution systems is very great. It is true that only a part and probably a small part of the total leakage is due solely to electrolysis, but it is only necessary to assume that a few per cent of the total is due to the more rapid developments of leaks caused by electrolysis in order to make the total loss resulting from this cause run well into the millions annually.

In making a valuation of underground pipe systems, as, for example, in the case of a valuation to be used as the basis for a transfer of property or for rate revision, it is necessary to consider possible deterioration of the pipes due to electrolysis, since in those localities in which the pipes have suffered from electrolysis the actual physical value of the system will be materially reduced.

#### Inconvenience and Hazard Due to Electrolysis.

It is not alone the property loss, however, that makes the electrolysis problem one of importance. An important fact is the inconvenience to consumers of water, gas, and telephone service due to the interruption of the service when repairs are made necessary by electrolytic damage. Possible interruption of the service of police and fire-alarm systems is also one of considerable importance to almost every municipality.

Wherever currents are permitted to flow on the underground pipe systems there is the possibility of electric arcs being formed when pipes are disconnected, or when different pipe systems make momentary contact. Accidents of this kind are rare, but they have sometimes occurred, resulting in the loss of life and a considerable damage to property. Cases have occurred also in which leakage of gas resulting from electrolytic corrosion of the pipe has given rise to explosions with disastrous results. Many gas explosions in basements and manholes have occurred, and although it is difficult to determine what proportion is due to electrolysis, undoubtedly some of them are due to this cause.

A water-pipe line weakened by electrolytic corrosion may even present a fire hazard much greater than would result from interruption of water supply at normal times. In many cities it is quite common practice during bad fires to increase temporarily the water pressure in the district adjacent to the fire. It is very obvious that a badly corroded water main might be capable of withstanding the normal pressure on the system and thus give no warning of the weakened condition of the pipe, but at the critical juncture during a bad fire when the pressure is suddenly increased the pipe may burst, and thus seriously hamper the work of fire fighting. It will readily be appreciated that in any region in which electrolysis damage is known to be in progress to a greater or less extent the mains

are far more likely to break at these critical times than at any other period, and thus a real, though indirect, fire and life hazard due to electrolysis must be recognized.

### Methods of Mitigation of Electrolysis.

While actual dangers resulting from the presence of stray currents on underground pipe and cable systems may readily be obviated, the use of improper methods may aggravate rather than relieve the seriousness of the trouble. In not a few cases so-called mitigative measures which were actually harmful in their effect, either to the system to which the measures were applied or to neighboring structures, have been installed. Altogether more than 25 separate and distinct methods of dealing with the electrolysis problem have been proposed and experimented with from time to time. Some of these are very beneficial when properly used or may become harmful when improperly used; and others, while harmless in their effects on the pipes, may be of no appreciable value and, hence, a useless expenditure of time and money. It is easy, therefore, to appreciate the difficulties confronting the nontechnical man, or even the engineer who has not given special study to the electrolysis problem; and this emphasizes the need for a more general understanding of the fundamental principles of electrolysis by officials of utility companies operating underground pipe and cable systems.

The Bureau has been studying the electrolysis question for the past seven years and has done a large amount of work in connection with it. The first problem investigated was that concerning the effects of electrolysis in reinforced concrete, after which special attention was given to electrolysis of underground pipes. This has included laboratory investigations concerning the effects of electric current on concrete and metal pipes, tests of pipe coverings, the corrosion of metals in the soil, methods of measuring soil resistance and various other experimental phases of the work; methods of electrolysis mitigation that have been used or proposed; field studies in actual practice with the application of remedies; and a determination of the cost and results obtained.

Extensive investigations have also been made into methods of electrolysis testing in the field for the purpose of establishing the best methods of procedure in diagnosing the cause of troubles actually experienced, determining the extent to which the underground metallic structures are being affected, and securing engineering data on which to determine the most effective and economical measures that may be applied in any given case to mitigate the trouble.

### Recent Electrolysis Work of the Bureau.

The Bureau of Standards has made a number of electrolysis surveys in various cities with the view of making detailed studies under typical conditions, the results of which could be published for the benefit of the public. These investigations have been made in co-operation with utility companies and municipalities concerned and largely at their expense. Complete mitigative systems have been installed by several cities, demonstrating the most effective means of meeting the problem under various conditions. The Bureau makes somewhat detailed tests in each of these places about once a year to make sure that the protective systems are being properly maintained.

Arrangements have been made for carrying out investigations on the three-wire system of electric railway operation. A system of this kind has been installed at Omaha, Nebr., and a comprehensive series of tests have been made with very gratifying results. An account of these tests will be published during the coming year. The same system is now being installed in Springfield, Mass. This latter system was projected more than a year ago, but owing to local conditions it was necessary to defer installation until now. It is expected that this system will be in operation by October, and a careful examination of it will be made by the Bureau.

During the past year brief electrolysis investigations have been made in about 10 southern cities. Complete electrolysis investigations have been made in Montgomery, Ala.; Hamilton, Ohio; and Omaha, Nebr.; and reports have been submitted to the municipalities and public utilities operating in those cities. A similar investigation is now in progress in the city of St. Paul, and arrangements have been made for undertaking an investigation in Duluth, Minn.

At the present time the amount of this work which the Bureau is doing has been greatly restricted because the majority of the members of the staff who have been engaged in this work have been needed for work in connection with urgent military problems. Precedence will be given to these military problems as long as it is deemed necessary, but the electrolysis work will be resumed after the existing emergency has passed.

#### **Leakage of Current from Electric Railways.**

The Bureau has continued work in regard to the effect of treated ties on the leakage of current from electric railway lines. This work is being done in conjunction with the forest products laboratory.

#### **Advice to Municipalities and Corporations.**

In addition to the work of the Bureau outlined above, the results of which are being published from time to time for general distribution, the Bureau renders an important service to the public through the advice given to municipalities and corporations by correspondence and personal consultation. Frequently representatives of utility companies and cities come to Washington for personal interviews relating to various phases of the electrolysis and public-utility problems.

#### **Lightning Protection.**

Considerable work has been done in the direction of preparing specifications for the protection of buildings against lightning, but owing to the emergency growing out of the military situation it has been necessary to suspend this work temporarily. A little later, as soon as opportunity affords, this work will be continued and specifications will be prepared for protecting different kinds of buildings and other structures, so as to make it easier for architects and owners who wish to place lightning protection on different types of structures to do so as efficiently and economically as possible.

#### **Investigations on Grounding of Secondary Electrical Circuits.**

Grounding the secondaries of transformers and other parts of electrical systems to protect persons and property from electrical

dangers has, in recent years, become an important item of consideration to power companies. In view of the lack of readily accessible information on this subject the Bureau began in 1915 an investigation with the object of presenting in a suitable form the data then available, and supplementing it as far as seemed necessary with laboratory and field work. This investigation has been carried far enough to enable the preparation of the technological paper, soon to be published, which covers the following topics: (1) Resistance of ground connections; (2) their uses and service conditions; (3) different forms of ground connections and the electrical characteristics of each; (4) mechanical construction; (5) inspection and testing; (6) fire hazard and interference with service; (7) costs; (8) bases for specifications; and (9) field measurements of the resistance of ground connections.

### **Experimental Study of Telephone Apparatus.**

With the funds at present available, progress in this important and most widely used branch of public-utility service must necessarily be slow. The increasing attention devoted to the subject by public-service commissions and the general public interest in this field make it desirable that increased funds be provided for this work.

Attention has first been directed to the establishment of a standard for the measurement of telephonic transmission efficiency, which in the interest of uniformity and in order to avoid all possibility of dispute relative to transmission measurement, should be in the custody of the Federal Government. The Bureau is now in position to make measurements of transmission efficiency and has made considerable progress in the development of an improved standard of transmission.

A large number of comparisons of the efficiency of transmitters and receivers of different makes have been made when using the voice as a source of sound, and in addition a study has been undertaken of the effect of the length of subscriber's lines in common battery systems with relation to the efficiency of transmitters of various types and makes.

In order to interpret the results of transmission measurements intelligently, even in the case of the relatively simple circuit employed in the definition of the transmission standard and particularly in the much more complicated circuits met with in actual practice, a thorough understanding of the theory of transmission engineering is necessary. A study has been made of the theory of transmission over uniform and composite lines; artificial lines; the effect on transmission of the electrical constants of the terminal apparatus in their relation to the constants of the lines to which they are connected; the effect of line apparatus such as repeating coils, and other means of connecting two portions of a telephone circuit, as well as signalling apparatus. Such studies lay the foundation for the formulation of the conditions to be met to give the maximum transmission efficiency at a given frequency.

This work must be supplemented by experimental work which has already been begun at the request of operating and manufacturing interests. Owing to the complexity of the present-day telephone

circuits, this is a laborious undertaking, involving not only the development of suitable methods of measurement and the making of measurements under the manifold conditions met in practice, but also the determination of the electrical constants of representative types of telephone apparatus under service conditions. Such work will not only be of great general value, but its bearing on the consideration of questions raised before commissions as to the feasibility of physical connections between different telephone systems is also manifest. The work involves the measurement of alternating currents, voltages, frequencies, and phase relations in the telephonic range.

The development of a method for determining telephonic transmission efficiency by other than speech tests is deemed essential. Such a method is much needed because speech tests are not entirely satisfactory on account of relatively large errors of measurement (due in considerable part to variations in the carbon transmitter of the standard circuit), especially where it is a question of determining the effect of small differences such as those involved in determining the influence on transmission of repeating coils, condensers, and other apparatus used in talking circuits.

On account of resonance phenomena, especially in receiver and transmitter diaphragms, single-frequency measurements can not be satisfactory. It is therefore necessary to base results on measurements at three or more selected frequencies combined in accordance with the amplitude and frequency characteristics of speech. The determination of these characteristics is a fruitful field for further investigation.

In order to carry on effectively the investigations outlined, considerable specially designed apparatus must be acquired, and the personnel in charge of this work must be considerably enlarged.

#### **Telephone Service Standards.**

The investigation of the principles underlying the definition of telephone-service standards is of the greatest importance to State public-utility commissions as well as to the millions of telephone users throughout the United States. In order to secure results of greatest value, it is necessary to enlist the cooperation of the telephone industry, which will of course be benefited by such work. In view of this fact the Bureau confidently counts upon its wholehearted support.

#### **Submarine Telegraphy.**

In connection with a fraud order case of the Post Office Department in which the Bureau was asked to cooperate, a study of cable signaling and a portion of the broader field of transient phenomena were taken up. Of particular interest in this connection is the effect of terminal apparatus, cable relays, and amplifiers and the Squier method of alternating-current signaling, especially as related to the speed of working. Experiments were made to demonstrate the impossibility of claims to the effect that telephonic communication could be had over long lengths of submarine cable of the types now in use. Numerous tests by the aid of a 1,000-mile artificial cable clearly indicated that the telephonic transmission apparently obtained is not true cable transmission and is easily explainable by

leakage and unbalanced capacities to ground. The results obtained are all in conformity with theory.

### **Relation of the Bureau to Municipalities and Public-Service Commissions.**

In many States the public-service commissions have set standards of service, and the Bureau has cooperated with most of those that have done so. In other States the railroad or public-service commissions have taken no action in the matter, although having authority to do so. Again, in some States there are no public-service commissions to issue regulations or to inspect the quality and safety of the service rendered by the various utilities. In any case the cities and towns must look after their own interests, in whole or in part, and frequently have taken up such matters very successfully. Where there are well-equipped and active State commissions, which have adopted rules and are ready to hear complaints regarding rates or service, a very large responsibility rests even in such cases upon the municipalities. Few State commissions will ever be likely to have a force of engineers and inspectors large enough to enable them to take the initiative in every case and relieve the municipalities of all responsibility. On the contrary, if the municipalities are active and enterprising in their own behalf, and if the larger ones have well-equipped public-utility departments which can prepare the city's complaints or requests and take them up to the State commissions for hearing and adjudication, the State commissions would be better able to serve all the municipalities of the State, and the municipalities would enjoy in large measure the advantages as well as the responsibilities of home rule without its greatest disadvantages.

But for most cities and many commissions it is a difficult matter to judge as to the quality of service rendered by its utilities. The studies made by the Bureau are a great help in this connection, but much remains to be done. It will conduce to fairness and a good understanding to have the subject studied further and as definite and complete specifications as possible made available for all branches of public-utility service.

Obviously, it will never be practicable for any State commission or city to handle these questions alone. Though they possess large and able engineering staffs or employ specialists for each separate problem, the question of what is good service or whether the service in any given case is adequate, safe, and satisfactory can be settled only by reference to what is done under similar circumstances elsewhere in the country. In other words, standards of good practice and good service are largely determined by general experience and should be studied comparatively, using the experience of the entire country. The Bureau has been doing this for several years, and although it has not been able to do as much as it would have liked to do, it has done enough to demonstrate the practicability and acceptability of the method. The success and approval which the work has met so far fully justify its greater development.

### **Necessity for Increasing the Public-Utility Work of the Bureau.**

The sum available for the public-utility work of the Bureau during the current fiscal year, including a special appropriation for the safety work, is \$65,000. Many of the States spend more than this and



some States 5 or 10 times as much. The people of the United States spend about \$2,000,000,000 a year for the service of the public utilities, or \$20 per capita per annum. This includes the telephone, gas, electric light and power, electric-railway transportation, and miscellaneous utilities, not including the steam railways. The States through their public-utility and railroad commissions spend about \$4,000,000 a year regulating the utilities and railroads and the cities a large amount in addition, but very little of this is spent for research. A considerable sum could profitably be spent annually in an efficiently conducted cooperative study of the conduct of such utilities, defining standards of service, preparing safety rules, assisting in local studies as to service, acting as referee or adviser in cases of dispute, serving as a clearing house of information on all public-utility and associated engineering questions, helping to secure uniform methods of accounting (especially where public-service commissions are not yet established), carrying out laboratory tests and investigations to answer difficult questions, and making it possible for rules as to service and safety to be kept revised up to date after they have once been formulated and adopted. Such work carried on with the cooperation of the utility companies and commissions requires a great many conferences and discussions and the harmonizing of differences of opinion. Many such differences of opinion are due to lack of precise information. Often experimental or other studies clear up such differences and bring about uniformity of practice.

A Federal bureau well equipped with men and apparatus, and permitted to work in the very wide field of public utilities (outside of railroad transportation and such subjects as the Interstate Commerce Commission is concerned with) can accomplish great good for the public. It does not appear to be overestimating the value of such work to say that an average benefit equivalent to 5 per cent of the sum now paid for the service would result. It seems conservative to suppose that such benefit in improved efficiency and better service would seldom be less than 2 or 3 per cent and sometimes as high as 10 per cent. Five per cent of \$2,000,000,000 is \$100,000,000 per year, and this appears to be a reasonable estimate of the possible value of the service being considered, assuming such service to be efficient and ample. One cent a year per capita is only a hundredth part of this sum, and this does not seem too much for the people to spend cooperatively through the Federal Government to accomplish this result. Considering the enormous cost of public-utility service, it does not appear to be desirable to continue spending so much without a greater effort to derive the benefits possible from a just and adequate system of public-utility regulation.

The money value of proper regulation of the utilities is not the only benefit to be derived therefrom, however. The increase of safety is another consideration difficult to estimate in dollars and cents. Still another advantage, more difficult to appraise but not difficult to appreciate, is the favorable influence on State and municipal government. Unregulated utilities sometimes control municipalities; improperly regulated utilities are sometimes forced to resort to questionable methods of self-defense. Public officials charged with the duty of regulating public utilities, but not provided with the means of doing it equitably and effectively, are at a serious dis-

advantage and frequently can accomplish nothing. The eagerness with which public officials with whom the Bureau has cooperated in the past have sought reliable information and their appreciation of the work of the Bureau indicate that if this work could be greatly enlarged and made available in a larger number of cities and States, it would be of immense economic importance and by establishing a better understanding between utilities and the representatives of the public would have a salutary effect upon municipal government. It would also benefit the public utilities themselves, partly by increasing their efficiency and partly through the increased confidence of the public in the fairness and efficiency of this arrangement.

#### 4. LIGHT AND OPTICAL INSTRUMENTS.

[Wave length of radiation (visible and invisible); color, relative emissivity, reflectivity, and absorption of materials for light and other radiation; transparency; and radiation constants, including experimental researches required in determining the optical constants of materials and of radiations; in developing optical standards of performance or quality of optical products for manufacturers, technical experts, and research laboratories; in the standardization and testing of sugar and other materials by optical means; and in standardizing the measurement and specification of colors for such industries as dyes, paints, ceramics, paper, inks, etc.]

##### Determination of Standard Wave Lengths.

A considerable number of very accurate determinations of wave lengths of light is required for spectroscopic work. Such wave lengths will serve as standards for the accurate measurement of wave lengths corresponding to lines in the spectra of the chemical elements. These standard wave lengths are measured by the interferometer method and are expressed in terms of the red radiation of cadmium which is the fundamental spectroscopic standard. During the past year the Bureau has increased the existing number of secondary standards by measuring the wave lengths of 12 cadmium lines, 21 helium lines, 56 neon lines, and 24 argon lines. These lines are quite sharp and it has been possible, therefore, to measure the wave lengths with an accuracy of one part in four or five millions. They are scattered throughout the spectrum from the ultra-violet, at 2900A, into the infra-red to 8500A. The abbreviation for angstrom is A and its length is one ten-millionth of a millimeter.

The study of numerical relations between different spectrum lines has been begun in connection with these accurate wave-length measurements. A well-known series formula has been tested with the helium wave lengths and the results are contained in Scientific Paper No. 302. In the neon spectrum it was discovered that frequencies corresponding to several groups of lines are the same to one part in about five millions. These are no doubt the most exact numerical relations ever observed among spectrum lines and are of great importance from both practical and theoretical standpoints.

##### Infra-red Photography.

A large part of the spectroscopic investigations of the Bureau during the past year has been in the longer wave regions of spectra, to which ordinary photographic plates are insensitive. These regions were recorded on ordinary plates which were stained with certain photographic dyes. The comparative efficiency of several dyes as

red and infra-red sensitizers for photographic use has been investigated; pinacyanol was found best in the orange and red, and dicyanin most valuable in the adjacent infra-red spectral regions. With the use of these dyes the wave-length interval which may be photographed with ordinary plates is easily doubled and extended to about 2000A beyond the visible limit in the red. The value of these dyes has been demonstrated by the photography of the infra-red spectra of laboratory sources, of the stars, and of the sun. At present these photographic dyes are not made in this country, although their importance in scientific work and in the industries warrants the expenditure of a large amount of effort upon their production and upon the search for new ones.

Up to the present there has been comparatively little accurate spectroscopic investigation of light waves longer than those of yellow light. The important red and infra-red regions have never been explored with the same completeness as the other regions. It is very desirable that this be done in order to establish a broader basis for spectroscopic chemical analysis as well as for more general reasons. Ordinary plates stained with dicyanin have been used at the Bureau to photograph the arc spectra of 20 of the chemical elements, including the alkali metals, the alkaline earths, and elements commonly found in iron as impurities. The photographs were made with a large concave grating and the wave lengths were determined relative to the international secondary standards in the spectrum of the iron arc. The wave lengths photographed with these stained plates range from 5600A to 9600A and the results for 10 chemical elements are published in Scientific Paper No. 309. Frequency differences of pairs of lines in the spectra of sodium, potassium, rubidium, caesium, and copper are shown by these wave-length measurements to be constant, in most cases, to 1 part in 100,000 in the number of waves per centimeter. Comparison of the spectra made it possible to detect many impurities in the elements, and this feature of the work will, no doubt, be of considerable importance in chemical analysis. The spectra of neon, argon, krypton, and xenon gases were also photographed in the infra-red by means of the grating and dicyanin-stained plates. Many new lines were thus recorded and some striking similarities in the spectra of these gases were found. In the xenon spectrum what appear, by analogy with the other rare gases, to be the principal lines were observed for the first time.

Through the courtesy of Director E. C. Pickering, of Harvard University, the 24-inch reflector of the Harvard College Observatory was used for the purpose of extending the photography of long wave lengths to stellar spectra. The results have shown the feasibility of extending observations on stellar spectra to greater wave lengths than has heretofore been possible. A new absorption band was photographed at the end of the visible spectrum and later laboratory experiments at the Bureau have confirmed the conjecture that this is due to titanium oxide. There is found in this experience another example of the stimulating effect of celestial spectroscopy on laboratory investigation. The general conclusions of this work may be stated as follows: (1) Many stellar spectra possess sufficient intensity in the region of wave length 8000A (infra-red) to enable this portion of the spectrum to be photographed on plates

sensitized with dicyanin; (2) in favorable instances stellar spectra can be recorded to wave length 8500A or possibly to even greater wave length; (3) the region of stellar spectra beyond 7000A contains features of importance to astrophysics, especially in the case of the red stars.

The Johns Hopkins University kindly placed at the disposal of the Bureau, a suitable grating and auxiliary apparatus for the photography of the solar spectrum. Dicyanin-stained plates made it possible to record the spectrum of the sun from the red at 6800A into the infra-red at 9600A. The dispersion and fine detail of these photographs is nearly comparable with that of Professor Rowland's map of the solar spectrum from the ultra-violet limit to the visible red. The measurement of wave lengths corresponding to the absorption lines and comparison of these with the lines obtained from laboratory sources will make possible additional identifications of chemical elements in the atmosphere of the sun.

### Refractive Index and Dispersion of Air.

It has become necessary to investigate the optical properties of the air, since they have not been determined with sufficient thoroughness for the reduction of some of the wave-length measurements. For example, the difference in the index of refraction of the air for different wave lengths must be taken into account in the measurement of secondary standards of wave length, and for the proper discussion of numerical relations among spectrum lines it is necessary to reduce wave lengths which have been measured in air to their value in a vacuum. This requires a knowledge of the index of refraction of air of various densities for a large range of wave lengths. Over 1,000 observations have been made on the index of refraction of air for wave lengths from 2500A to 9000A, which is the entire spectrum range easily recorded by direct photography. These observations were made for several temperatures between 0° C. and 60° C. and for several pressures ranging from zero to one atmosphere.

### Spectroscopic Analysis.

The spectroscopic method of analysis has some advantages, within certain limits, over the chemical method of analyzing chemical compounds. In some cases the quantity of the sample is too small for a successful analysis by chemical means. The spectroscopic method can be used to test the presence of all the constituents of a compound in a single small sample, while the chemical method often requires several portions of the material, each one of which is separately examined for a certain element or group of elements. Furthermore, a spectroscopic analysis can generally be made much more quickly and easily than a chemical analysis. For these reasons considerable time has been given to developing both qualitative and quantitative analyses by spectroscopic methods.

A large number of standard samples of alloys were prepared by metallurgists and carefully analyzed by chemists. The spectra of these definitely prepared and analyzed samples were then compared with the spectra of samples of unknown content. In this way the unknown specimens were analyzed with accuracy. This method has been especially valuable in the analyses of boiler safety plugs of

fusible tin. Several hundred such plugs have been examined and found to average 0.2 per cent copper, 0.1 per cent lead, 0.05 per cent zinc, and 0.07 per cent iron. The specifications for these plugs allow 0.3 per cent total impurities and the spectroscopic method is now very simple if the impurities fall within this range. An analysis of 10 plugs can be made in about 90 minutes in this way, while the chemical methods require about three days. Thirteen aluminum alloys were examined spectroscopically and the type of alloy determined. Thirteen samples of zinc ore, electrolytic zinc, and muds from electrolytes were examined for rare elements by spectroscopic means. A number of iron, steel, brass, platinum, and glass samples have also been examined. All the glass samples contained lithium and it was found possible to make comparative determinations of the sodium and potassium content which were roughly in accord with the chemical analyses.

The spectroscopic method of analysis is extremely sensitive and often detects impurities which escape the chemical method. In cases where the chemical quantitative analysis can not be replaced by the spectroscopic method, a rapid preliminary spectrum qualitative analysis often saves the chemist much time.

#### **Rare Gas Discharge Tubes.**

The spectra of the rare gases can only be examined by confining small quantities of the gases in glass or quartz tubes and sending an electrical discharge through them. The design of these tubes is a matter of much importance and has received considerable attention at the Bureau. Both glass and fused quartz tubes containing hydrogen, helium, and argon have been made. Some of these tubes were required in work at the Bureau, and several were furnished to other Government bureaus and to scientific institutions. It was found possible to make excellent discharge tubes of argon directly from the air. A small bulb of quartz or Pyrex glass was filled with calcium chips and attached to a tube containing air. Maintaining the calcium at a temperature of about 300° C. for several hours abstracts all of the nitrogen and oxygen and leaves quite pure argon in the tube at about the proper pressure for spectroscopic work. The frequent requests for the rare gases and their great importance and promise in scientific work demands the production of neon, argon, krypton, and xenon on a larger scale.

#### **Solubilities in the Sugar Group.**

The data obtained on the solubilities of sugars and on the influence of foreign substances upon these solubilities have an industrial as well as a scientific importance. The preparation of the sugars of commerce always involves their crystallization from impure solutions. The quantity of sugar which can be obtained by a crystallization depends upon its solubility in the presence of the particular impurities which occur in the crude materials. Cane and beet molasses are simply solutions of sugar in water containing large quantities of mineral salts and invert sugar.

During the past year the Bureau has investigated the solubility of sucrose in the presence of glucose and invert sugar (invert sugar, obtained by the decomposition of sucrose, is a mixture of glucose

and levulose), and the solubility of glucose in the presence of sucrose and levulose. The results thus far obtained show that the conclusions reached by previous investigators are incorrect. The investigation is being continued and the influence of mineral salts is being studied. In this manner it is intended to study individually the constituents that make up the complex systems in molasses.

### **Influences of Temperature on the Speed of Inversion of Sugar.**

Under the influence of acid, sucrose decomposes to form a mixture of two sugars, namely, glucose and levulose. This mixture is called invert sugar. The decomposition or "reaction" occurs with a measurable velocity which is very sensitive to temperature influences. This reaction is used to estimate sucrose quantitatively when other optically active substances are present. The technique of this method is in need of improvement on account of its wide application in the analyses of sugar mixtures. As a first step the velocities of the reaction for the range of temperature employed have been determined. The experiments consisted of measurements of reaction velocities at relatively great velocities. The results of the experiments showed that the velocities could be expressed by a mathematical formula which had been derived theoretically by previous workers.

### **Specifications for Commercial Grades of Sugar.**

One of the most important problems confronting the sugar industry, both from the standpoint of the manufacturer and the public, owes its origin to the absence of definitions or specifications of the various grades of commercial sugars. This matter has been brought to the attention of the Bureau a number of times. Considerable difficulty has been experienced by manufacturers of candy due to variations in the sugar, it frequently being necessary to modify the formulas of candies on this account. In another instance the Navy Department was furnished with an inferior grade of sugar by a contractor. Recently the question of specifications which would define the different grades of commercial sugars, both white and brown (or soft) sugars, has been brought up by domestic producers.

From preliminary investigations the Bureau is convinced that, owing to the variations in quality which now exist, the work of preparing rigid specifications for the grades currently on the market will be considerable, but once such specifications are established the uncertainties of quality in the different grades of sugar will be practically eliminated. The Bureau hopes to be able to carry out this important investigation in the near future.

### **Basis of Saccharimeter Standardization.**

The results of the Bureau's investigation of the present basis of standardization of saccharimeters were set forth in the last annual report. The most important item was the correction of an error of over one-tenth per cent in the 100-degree sugar point of the saccharimeter scale, the net result being the saving of \$60,000 annually in the revenue of the Government from imported sugar and a much larger gain to the producers of sugar. Owing to the present conditions in Europe, the Bureau has abandoned hope for the present of a correction of this error by the international committee which

was appointed to make a recommendation regarding the matter. Despite this fact the Bureau has concluded that it is no longer warranted in standardizing sugar-testing apparatus on a basis now known to be in error. Accordingly, certifications will be changed at an early date to the new value of the 100-degree sugar point of the saccharimeter.

### **Constants of the Quartz-Wedge Saccharimeter.**

The Bureau has described, in Scientific Paper No. 268, the preparation of pure sugar and the many critical tests made to establish its purity. This substance was used to fix accurately the 100 per cent point of the saccharimeter in order that sugar analysis in connection with the sugar industry and for tariff assessment purposes might rest on a proper basis. Sugar in common with a large class of other substances alters or "rotates" the plane of vibration of plane-polarized light by an amount almost exactly proportional to its concentration. This property has been utilized for the exact analysis of these substances in instruments called saccharimeters and polarimeters.

It is now proposed to extend the investigation to the remainder of the sugar scale in order to ascertain the corrections to be applied for changing concentration of sugar. Thus the 80, 60, 40, and 20 per cent points on the scale will be determined with the same precision as the 100 per cent point. It is hoped in this way to establish a valid working basis for accurate sugar analysis.

At the same time precision measurements of the rotations of the sugar solutions will be made on the polarimeter. These measurements will supply data for the calculation of the variation of the specific rotation with changes of concentration of the sugar solution.

### **Rotation of Quartz at High Temperature.**

The natural and magnetic rotation of light by crystalline and quartz, and the magnetic rotation of light by the amorphous quartz have been studied at high temperatures. Additional knowledge of the properties of quartz is of special importance from the theoretical standpoint, because of its extensive use in polariscopes and other optical instruments and because of its relation to the problems involved in the study of the history and formation of the earth. Crystalline quartz has a transition point at about 575° C.; at this temperature the crystal changes over into another crystal form. This is shown in the experimental curve of the natural rotation by an abrupt change of direction. Above this point the temperature has little effect upon the rotation, while just below it a small change in temperature causes a large change in the rotation. On the other hand, the magnetic rotation of both the amorphous and crystalline forms is found to be practically independent of temperature, increasing very slightly as the temperature rises and showing no change at 575° C.

### **Magnetic Rotation by Magnetic Substances.**

A research has been undertaken on the magnetic rotation of metallic films, namely, iron, iron oxides (hematite, magnetite, etc.), and nickel, from room temperature to temperatures as high as possible (about 1,000° C. in some cases). This work has opened a field

which has heretofore been unexplored. The behavior in this region of the substances mentioned is of great theoretical importance, existing theories having been based on the experimental facts observed at ordinary temperatures.

The experimental difficulties involved in carrying on the work are necessarily numerous and difficult to overcome. A powerful electromagnet placed between the polarizer and analyzer of a very sensitive polariscope was used, the pole pieces being perforated to allow the beam of light to pass parallel to the lines of force through the substance in the magnetic field. Specially constructed furnaces to obtain the high temperatures were required. These furnaces had to be small enough to go in between the poles of the magnet and yet give a uniform temperature. Thermocouples and a sensitive electrical apparatus were utilized for taking temperature measurements. A gas-tight furnace was necessary for the work on the metallic films, so that the film could be kept in an atmosphere of hydrogen, oxygen, or other gas during the experiment, a long quartz and glass tube extending through the magnet being used for this purpose. The film to be observed was placed inside this tube, and the furnace was slipped over the outside of the tube containing the film in such manner that the film was in the center of the furnace and in the center of the magnetic field.

The results obtained show that the magneto-optical effect (rotation of the plane of polarized light) becomes zero in the ferromagnetic substances at the temperatures at which their magnetic properties are lost. This effect is especially clear and sharp in the case of nickel, the rotation falling abruptly to zero at about  $360^{\circ}$  C., the temperature at which nickel loses its magnetism. In the case of iron, the phenomena are much more complex. With the increase of temperature from room temperature, the magnetic rotation begins to decrease rapidly. It rises again somewhat at about  $300^{\circ}$  C., indicating that some change or transformation is taking place, then gradually falls off again to practically zero at about  $780^{\circ}$  C., the  $A_2$  transformation of iron. The films were deposited electrically on thin quartz plates placed in a high vacuum.

#### Bureau of Standards Baumé Scale.

The existence and use of over 20 different Baumé scales have caused considerable confusion and misunderstanding in the industries. These are arbitrary scales, used indiscriminately, in the determination of the density and the percentage of sugar in solutions. The great importance of correcting this situation is shown by the action of the Association of Official Agricultural Chemists at their last meeting in recommending that the Bureau of Standards make a study of the problem, with the object of establishing a suitable standard Baumé scale for use in the sugar industries. The Bureau has already recognized the need of such a scale and had previously conferred with several persons prominent in the field of sugar analysis. The matter was taken up in cooperation with the division of weights and measures of this Bureau and a new Baumé scale, together with tables for its use giving equivalents in per cent sugar and specific gravity, was constructed. The new scale is to be used at  $20^{\circ}$  C., the standard temperature in sugar analysis.



The advantages of the new Bureau of Standards Baumé scale are shown by the following: (1) It is based upon the specific gravity values of Plato, which are considered the most reliable of any available; (2) it is based on 20° C., the most convenient and widely accepted temperature for sugar work; and (3) it is based on the modulus 145, which has already been adopted by the Manufacturing Chemists Association of the United States, the Bureau of Standards, and by all American manufacturers of hydrometers.

#### Standard Glassware for Customs Laboratories.

The Bureau has undertaken to interest American manufacturers in the production of standard glassware, owing to the difficulty experienced by the Treasury Department in obtaining suitable glass apparatus for use in the testing of raw sugars. Specifications were sent to a number of makers and very favorable replies were received. It is thought that, in future, the American manufacturers will be able to meet the demand for these supplies.

#### Circular on Polarimetry.

There has been a rapid growth in recent years in the applications of polarimetry to the arts and sciences, with a proportionate increase in the requests made upon the Bureau for information. Circular 44, on Polarimetry, which includes a résumé of the work done at the Bureau of Standards and elsewhere, has to a large extent furnished the desired information. It has been revised and considerable matter added in the appendixes. The new material comprises 10 tables, including the new Bureau of Standards Baumé scale for liquids heavier than water, results of recent researches, a consideration of the polarization of low-grade products, a résumé of the work of the International Commission for Uniform Methods of Sugar Analysis, and amendments to the United States Treasury Department Sugar Regulations.

#### Polarimetric Tests of Raw Sugars.

The present disturbed conditions in freight transportation have resulted in raw sugar importations being entered at unusual points. However, the samples received by the Bureau were mainly from the larger customs ports. There were 1,243 samples of raw sugar tested. About 50 per cent were direct polariscopic determinations of the quantity of sucrose present, and the remainder were tested for the percentage of moisture in addition to the direct polarization.

#### Sampling Molasses in Tank Cars.

Owing to the conditions prevailing in water transportation, large quantities of molasses are now shipped in tank cars from Cuba by way of Key West. The merchandise is loaded in the cars at Habana and transported to Key West by ferries and, thence, to numerous points in the country by rail. The securing of representative samples of molasses in the tanks has proven a difficult matter, and a member of the Bureau was sent to Key West to study the subject. This study has resulted in the preparation of suitable regulations covering the sampling of molasses in tank cars, and these regulations will be issued as soon as their preparation has been completed.

### **Polarimetric Tests of Molasses.**

The constantly increasing use of Cuban molasses in the United States has made it imperative that the Bureau give further consideration to the testing of this material. A number of samples have been studied and reported on. As yet, however, no satisfactory method for an accurate determination of the density of molasses has been found.

### **Information Furnished on Polarimetry.**

A further increase in the diversity of the information requested by the general public was noted during the past year. A considerable demand for information regarding older types of saccharimeters and other apparatus has arisen. The abnormal domestic sugar production and the scarcity of all kinds of sugar-testing equipment has made it possible for the Bureau to furnish much valuable assistance to the industry. In special cases the Bureau has departed from its established policy and made accurate adjustments on saccharimeters so as to render them fit for service. The manufacture of polariscope tubes and cover glasses, inaugurated by the Bureau in this country, has been continued with success. Present conditions have emphasized the importance of having all classes of scientific apparatus manufactured in the United States.

### **Polarimetric Testing.**

During the year there were tested about 500 cover glasses for optical homogeneity, and 24 quartz-control plates were standardized.

### **Standard Samples.**

Seventy-three standard samples of sucrose and seven samples of dextrose were distributed during the year. These materials are used principally for industrial and scientific purposes, such as the standardization of saccharimeters and for the determination of the heat value of fuels.

### **Installation of Sugar Laboratory at Savannah, Ga.**

A large sugar refinery was completed during the past year at Savannah, Ga. This made it necessary to establish a customs laboratory at that port for the purpose of collecting the revenue on sugar. The Bureau was requested to supervise the equipment and installation of this laboratory, which it did satisfactorily.

### **Supervision of the Customs Laboratories of the Treasury Department.**

The work of supervising the operation of the customs sugar laboratories has been continued with gratifying results. It was found necessary to modify the existing regulations owing to abnormal sugar importations, and as far as data are available, this has apparently been accomplished with no diminution in the accuracy of the tests. The port of Savannah has been added to the list of those ports sending samples daily to the Bureau for check analysis. The work of assisting the Treasury Department in improving the equipment, personnel, and efficiency of its general customs laboratories is progressing very satisfactorily.

### Color Standards Investigation.

For several years past urgent demands for advice and assistance in measuring and specifying the colors of light sources and materials have been made on the Bureau by various industrial and commercial interests. To enable the Bureau to develop methods and instruments to meet these needs, Congress made a special appropriation for the fiscal year ended June 30, 1917. Some of the fundamental work necessary in this investigation has been initiated and is in progress.

While some of the tasks comprehended in this investigation may be said to be completed or nearly so, the investigation is of such nature and magnitude that it must be continued several years before a general definitive report can be made. Besides undertaking the fundamental research problems in this investigation, a great deal of time and attention has been given (1) to the technical application of colorimetry and spectrophotometry to specific problems in industry, (2) to routine colorimetric testing by methods already established, and (3) to furnishing, on request, information and advice in regard to color measurements and color standards. In fact the aggregate attention necessarily given day by day to specific tasks and current correspondence of this kind is so great as to impede very much the progress on the main investigation and delay its completion. The instruments and methods used in this work are also applicable to certain military and naval problems; and in the present emergency these resources of the Bureau are being utilized, even though it involves delay in carrying out the fundamental work of the color standards investigation as originally planned. Some features of the colorimetric work are reported upon in the following paragraphs.

### Testing, Extension, and Improvement of Spectrophotometric Methods.

The physical basis of color specification is spectrophotometry. By this is meant the measurement of photometric intensities as a series of points through the spectrum. For example, suppose a yellow glass is to be tested; qualitative examination by means of a spectroscope will show that it transmits red, yellow, and orange light quite freely, while transmitting less green and little or no blue and violet. The function of spectrophotometry is to determine quantitatively the transmission (ratio of light transmitted to light falling on the glass) for each kind of colored light separately. Now each kind of colored light in the spectrum can be specified definitely by its wave length; and the result of such a test is a curve showing the relation of transmission to wave length. Such a curve determined with accuracy by reliable methods constitutes a unique specification of the color of the sample.

As mentioned in the report for last year, there was need of improving the methods for these determinations, particularly in the blue. This work has been undertaken as planned, and the spectrophotometric methods in use at the Bureau have been further tested and checked. Test specimens of various colors of glass have been carefully prepared and measured on one instrument (König-Martens spectrophotometer) at the Bureau. Through the courtesy of the

physics department of Cornell University, these same specimens have been again measured by a representative of the Bureau on an instrument of another type (Lummer-Brodhun) at Cornell and their transmissions for blue, violet, and ultra-violet also determined by a photographic method (Hilger sector apparatus). This procedure makes possible the detection of small errors and gives much more confidence in final results. Such counterchecking of results will be continued and elaborated. Apparatus is being installed for spectrophotometry by another independent method using the photo-electric effect.

### Fundamental Data Needed for Reference in Colorimetry.

The establishment of color standards and standard methods of color specification will require the compilation, systematization, and publication of a great deal of data and information, some of which is now available in the literature, and some of which will have to be obtained experimentally. It is planned to publish a circular and other special papers on this subject as soon as such matter can be put in proper form.

A great deal of time has already been given to compiling, computing, tabulating, and plotting data so as to have it in form convenient for reference in colorimetric investigations and tests. Among the data so prepared in tabular and graphic form during this year are the following:

(1) *Spectral Distribution of Radiant Power in Various Light Sources.*—The color of a light source is determined by the relative amounts of radiant power of different wave lengths which it emits. Thus, if the power emitted by a source consists entirely of radiation of a single definite wave length, it will give rise to a saturated color sensation corresponding to that wave length. If it contains radiations of various wave lengths, the color will be determined by the relative amounts of radiant power of these different wave lengths. The sun and all incandescent solids (carbon particles in oil and gas flames, the filaments in electric lamps, etc.) emit radiation of all wave lengths over a wide range but in very different proportions for the different wave lengths. Thus, while all of these lights are approximately "white," some are very bluish relative to others. It is of fundamental importance in colorimetric work to have available for ready reference curves showing the radiant power of various sources as a function of wave length (spectral distribution curves). Such data have accordingly been collected and plotted to a uniform standard scale. Also, the theoretical distribution of a perfect radiator at various temperatures, as given by the formulas of Wien and Planck, has been newly computed and plotted, using most recent data. The compilation of these data is of special interest because its consideration and discussion are necessary preliminaries to the definition of "white light," one of the first steps in the establishment of color standards.

(2) *Spectral Distribution Computed from the Rotatory Dispersion of Quartz.*—"Color screens" of known spectral transmission—that is, having a known transmission for light of each wave length in the visible spectrum—are of great importance in colorimetry. Colored glasses and dyed gelatine films are used to some extent for this

purpose, but they have the disadvantage that their spectral transmissions and, consequently, their colors are not readily adjustable at will nor conveniently and certainly reproducible. An optical system composed of a quartz plate between two nicol prisms may be used as a color screen, and the color is adjustable by varying the thickness of the quartz plate and the angle between the principal planes of the nicol prisms. The spectral transmission of such a system can be computed a priori with great precision, but such computations are exceedingly long and tedious. It has therefore seemed advisable to compute a great number of such curves for different constants and preserve them for ready reference. About 600 curves of this kind have now been computed and plotted.

(3) *Special Tables of the Trigonometric Functions Used in Photometry.*—In some photometric and colorimetric work the computations require frequent use of the square of the sine of an observed angle read in degrees and hundredths of a degree. There being no tables of this kind of sufficient accuracy available, a set has been computed as follows:

- (a)  $0^\circ$  to  $10^\circ$  at intervals of  $0^\circ.02$  to six decimal places.
- (b)  $10^\circ$  to  $80^\circ$  at intervals of  $0^\circ.02$  to four decimal places.
- (c)  $80^\circ$  to  $90^\circ$  at intervals of  $0^\circ.1$  to four decimal places.

The computation and copying of these tables has been carefully checked and photographic copies made for current use in the laboratory. They will possibly be published later. In the meantime a limited number of photographic copies may be supplied to those in need of such tables.

Less extensive tables of the fourth power of the sine and the square of the tangent have also been prepared.

### Establishment of Working Standards of Color.

Although the ultimate terms of a color specification should be absolute without reference to material colored standards or particular apparatus, nevertheless, working standards are important and essential. Some of the working standards of color to which attention is being given are the following:

(1) *Light of Known Standard Color.*—For the time being, working standards of light of known color have been provided by empirically color matching (by voltage adjustment) a number of vacuum tungsten lamps with a standard acetylene flame of previously known spectral distribution. These lamps have been numbered and marked and are preserved as the laboratory working standards for light of this color.

(2) *"Artificial Daylight."*—Another necessary working standard is "artificial daylight." There are on the market several combinations of lamps and colored glasses intended to give "artificial daylight." These have been developed by different experts on the basis of somewhat different definitions of "daylight." It is important that these be intercompared and that a standard "artificial daylight" be adopted. An investigation of these "artificial daylights" is now in progress at the Bureau.

An original method of producing "artificial daylight" has also been devised at the Bureau and developed theoretically and experimentally. It has been found by theoretical computations that the

spectral distribution of daylight can be approximately matched by light from an artificial source modified by transmission through a quartz plate between nicol prisms. The constants for such apparatus have been determined theoretically and the color match verified experimentally. A paper on this subject is in preparation for publication.

(3) *Colored Solutions.*—Various colored salts and other substances in solution have some value as working standards of color. It is important that substances used for this purpose have their spectral transmissions accurately determined. During the year the spectral transmissions of a number of such solutions, submitted to the Bureau and proposed as color standards, have been determined. A few other solutions have also been examined, and it is planned to extend this investigation to include as many as possible reproducible colored solutions of known purity and concentration. While there exist considerable previous data on this subject, they are largely qualitative or only crudely quantitative. The purpose of the present investigation is to obtain quantitative data of the highest possible accuracy.

(4) *Colored glasses.*—Colored glasses are also important as working standards of color. An extensive collection of colored glasses of standard manufacture is being made. The specimens are carefully prepared, marked, and filed in a systematic way. Their spectral transmissions are also being carefully determined by different methods and filed so as to be available for ready reference. It is intended to continually extend and augment this collection of glasses and data.

#### Design and Construction of Colorimetric Apparatus.

The design and construction of new instruments and apparatus are important features of the color standards investigation. The construction of the variation of thickness color comparator, mentioned in the report of last year, has been completed in the instrument shop of the Bureau, and the instrument has been installed and adjusted in the laboratory. The construction of a new trichromatic colorimeter is in progress.

*Specific Technical Applications of Colorimetric Methods.*—The end and purpose of the color standards investigation is to provide standard methods and apparatus needed to make color specifications possible in science, industry, and trade. The following are the important specific problems to which attention has been given this year.

1. *Specification of the Saturation of Yellow Tints in Butter and Oleomargarine.*—Frequent and persistent demands have been made on the Bureau to draft a form of specification which would be suitable to define rigorously in law a limiting value of what, in common parlance, may be called the "color," the "depth of color," the "strength of color" or the "yellowness" of butter and oleomargarine. In compliance with this demand, methods have been developed and definitely formulated, and a report on this subject has been published. (See Technologic Paper No. 92.)

2. *The Photometry of Lights of Different Colors and the Specifications of Their Colors.*—The determination of the relative candle-powers of lights of different colors is one of the most difficult problems of photometry, while the convenient specification of the color

of a light is the fundamental problem of color specification. A method which greatly facilitates the solution of both of these problems has been developed and tested. Reports upon this method have been made to the American Physical Society, December, 1916, and April, 1917, and published in the proceedings of those meetings in the *Physical Review*.

3. *Examination of Glasses Intended to Protect the Eyes from Harmful Radiation.*—There are on the market a number of glasses recommended to protect the eyes. At the request of the American Medical Association, the Bureau has undertaken to determine the spectral transmissions of a considerable number of these glasses. A great deal of this work has been done and a report will probably be published during the coming year.

4. *Color Grading of Cottonseed Oil.*—The investigation of the color of cottonseed oil has been continued, but has been delayed owing to the impossibility of securing certain needed apparatus. The effect of temperature on the rate of fading of the oil has been studied. It is found that the color fades, even in vacuum-sealed cells, somewhat more rapidly at temperatures from about 20° to 35° C. than below this temperature.

5. *Transparency of Paper and Tracing Cloth.*—To meet the demands of purchasers and manufacturers, a standard method for grading the transparency of paper and tracing cloth has been formulated and published. (See Circular No. 63.)

#### Information Furnished on Color and Color Specifications.

Information relative to color, color specifications, and related topics has been given to many applicants, both in personal conference and by correspondence. Among those to whom such information was furnished are the following: Refiners of oils; railway officials, architects, teachers of art, packing companies, textile manufacturers, paper manufacturers, manufacturers of optical apparatus, chemists, physicians, and the following departments and bureaus of the Government: Bureau of Chemistry, Navy Department, Bureau of the Census, Bureau of Lighthouses, Interstate Commerce Commission, Bureau of Entomology, and other branches of the service.

#### Tests of Color, Spectral Transmission, and Transparency.

A considerable number of tests of color, spectral transmission, and transparency have been made during the past year for the Navy Department, the Post Office Department, the Department of Agriculture, and other branches of the Government service, as well as for a number of industrial concerns and other interests.

#### Turbidimetry.

Turbidimetry is the quantitative measurement of turbidity. A medium is made turbid by the presence of minute particles in suspension, which scatter light in all directions. The quantity of scattered light can be taken as a measure of turbidity. A turbidimeter based upon this principle has been designed and constructed by the Bureau. With it every liquid examined, even the purest doubly distilled water, has been found turbid. The turbidity of relatively clean air is quite appreciable. The instrument measures a definite optical quantity, namely, the fraction of the incident light scattered by the turbid medium in a particular direction. This is the simplest quantitative

meaning that can be attached to the word turbidity used in an optical sense. The turbidimeter can, therefore, be used to define a new standard of turbidity.

The turbidity standard used in water analysis, as a guide to the efficiency of the filtration of municipal water supplies, has long been unsatisfactory. The Bureau has requested samples of standard turbidity from water laboratories representing the State and city boards of health. These have been received and are now being intercompared. The results will show the variation in the standard now in use, and will give the relation between the present and the proposed new standard. The Bureau will then be in a position to furnish a uniform standard of turbidity to the entire country.

#### Interference Methods for Measuring Thermal Expansion.

The apparatus, using the interference of light waves to measure thermal expansion, has been thoroughly tested and found to work satisfactorily. The expansion coefficients of several different makes of chemical glassware have been determined, the purpose being to find the relation of thermal expansion to breakage on sudden change of temperature.

The investigation of a new method for measuring the expansion of very small samples has been completed. The advantages of this method consist (1) of the smallness of the sample required; (2) the elimination of the difficulty of obtaining the interference fringe data, it not being necessary to count the passage of fringes during the temperature change nor to make measurements on fringes of more than one wave length; and (3) the very troublesome correction for change in the refractive index of air with temperature is eliminated. The results of this study were communicated to the Philosophical Society of Washington, and it is expected that a full description of this method will appear later as a scientific paper of the Bureau.

A method for determining the difference in expansion of these samples from the same specimen simultaneously has been devised and tested. It has been successfully applied in testing the relative expansions of various parts of rails in connection with the Bureau's investigation of the cause of failure of rails. This investigation is being continued.

#### Investigation of the Performance of American-Made Photographic and Projection Lenses.

An investigation was started on the relative performance of American-made photographic and projection lenses. European-made lenses have been very popular in this country, as they were supposed to be of the highest type of perfection. Very little is known of American-made lenses, as no comparative data have ever been published. A survey of American lenses would show where they could be used to best advantage. Several lenses were examined and measured, but it was considered impracticable to continue this work for the present, due to the difficulties under which the lenses have to be manufactured and the scarcity of good raw material.

#### Telephoto Lenses and Distance Photography.

Several types of lenses and cameras are being investigated in connection with their proposed utilization for photographing at great



distances. Certain data, such as the appearance of the rocks on an inaccessible mountain peak, become possible only when they can be photographed from an accessible point. One type of camera was developed which gave very good results in the laboratory. It will be further tried out under actual working conditions. Other types of lenses show very good promise and will be given further trial.

#### **Development of Optical Systems.**

The constants of some telescopes for use by the Navy Department were measured, and further work will be carried on to adapt the design to American-made optical glass. The different types of glass required for the Navy were reduced to four well-defined types. The standardization of the types of glasses used and of the types of telescopes will make possible production in the required quantity in the shortest time.

#### **Testing of Optical Systems.**

The Bureau has received a great many binoculars and telescopic instruments, both from the Navy and Army and from manufacturers with a view to improving the output. Especially has the amount of light let through been interesting. The early part of the European war forced the manufacturers to use inferior opaque glasses, thus producing binoculars with very low light transmission. Many tests were performed, and during the last year an improvement of over 50 per cent has been noticed. The field, resolving power, and general definition were well up to the standard.

#### **Refractive Indices.**

The amount which a ray of light is deviated in passing into a piece of glass is known as the refractive index. The refractive index changes with the wave length of light used, this change being known as the dispersion. These two constants determine the type of optical glass and the uses to which it is put. The manufacture of glass in this country has made measurements of this type very important, and a great many tests have been carried out for opticians and optical manufacturers. These constants are also very important in those industries where oils and liquids are used, where it is necessary to test the purity of these substances. Several tests were performed on oils at the request of manufacturing companies.

#### **Information Furnished on Optical Systems and Optical Glass.**

A great many inquiries have been received and answered regarding the adaptability and the practicability of optical instruments. Much time has been spent with the Navy Department in drawing up suitable specifications for various kinds of optical glass and optical instruments.

Many samples of optical glass have been tested for strain, striæ, refractive index, and transparency, to obtain an idea of the progress being made in their manufacture. The results are very gratifying.

The methods of testing optical glass for strain and striæ and the method for measuring the transparency of glass were requested by several manufacturers, so that they could be in a position to gauge their own progress. These methods are being fully developed in

order to make them commercially more practicable, and will be published in a circular as soon as completed.

### Optical Constants of Chemical Glassware.

In connection with the determination of the types of glassware in this country for chemical purposes, the strain has already been determined. An attempt was made to correlate the heat resistivity and physical strength with the strain and the refractive index of the glass, but it has been found very difficult, as composition and expansion of the glass and the thickness of the vessel play a very important part.

### Radiometry.

Various investigations have been continued in the general subject of radiometry, including the improvement of instruments for measuring radiant energy.

The application of the photoelectric cell as a precision instrument in radiometry was investigated. Several potassium photoelectric cells, made by Kunz, were compared with a bismuth-silver thermopile by determining the transmission of colored glasses in the blue and violet. This type of radiometer is not so easily affected by thermal disturbances as is a thermopile, and is therefore well adapted for certain special investigations.

A high resistance iron-clad Thomson galvanometer was constructed to replace the electrometer in photoelectric work. The device is from 35 to 40 times as sensitive as a low resistance galvanometer and a sensitivity of  $i=1 \times 10^{-12}$  ampere is easily attained on a three to four seconds swing. This galvanometer combined with a photoelectric cell is especially adapted for transmission and reflection measurements in the part of the spectrum extending from the blue into the ultra-violet.

A determination of the energy distribution in the visible spectrum of several gas-filled tungsten lamps, to be used as color standards, required considerable investigational work.

### Constants of Radiation of a Uniformly Heated Inclosure.

During the past year several investigations have been made of subsidiary problems connected with a further determination of the constants of radiation of a black body. An absolute thermopile for measuring the constant of total radiation in a vacuum was constructed and tested, as well as a vacuum-linear thermopile. The circle of the spectro-radiometer and its reading microscopes were modified and calibrated. New tungsten lamps were prepared for the optical pyrometer mentioned in the report of last year.

Measurements were made to determine the absorption of a 50-centimeter column of dry air, and of air containing water vapor, to determine whether there is a correction to the constant of total radiation data previously published. The results obtained indicate no correction when using air which is free from water vapor. The corrections to the observed data for losses by reflection from the radiometer receiver were recomputed and the value of the coefficient of total radiation was found to be the same as previously reported. These data are of importance in determining the scale of temperature at

high temperatures, and they are of interest in view of their intimate relation with the fundamental physical constants.

### Visibility of Radiation of the Average Eye.

It is important to know how the eye responds to lights of different colors but of the same energy value. During the past year the investigation of the relative sensibility of the average eye to light of different colors was completed. The visibility of radiation of 130 subjects was determined, and various applications were made of these data to problems in radiometry.

A solution of salts was prepared which has a transmission curve coinciding very closely with the visibility curve of the average eye. Using a cell containing this solution, interposed between a thermopile and a source of light, further tests were made of this combination as a physical photometer. Using these visibility data, computation shows that the eye is so sensitive that the minimum perceptible light is probably less than one billionth erg.

### Mechanical Equivalent of Light.

A mathematical equation was obtained of the above-mentioned visibility curve of the average eye. This equation was combined with Planck's equation of spectral radiation of a black body. Using the radiation constants of a black body and its brightness at various temperatures, it was possible to obtain the luminous equivalent of radiation or the so-called mechanical equivalent of light.

Independent checks of this constant were obtained by measurements upon an incandescent lamp of known candlepower, using the physical photometer mentioned in the preceding section. The data obtained by various methods indicate that the mechanical equivalent of light is of the order of 1 lumen = 0.0016 watt of luminous flux of maximum visibility, or 1 watt = 49 candles.

These data are of use in various physical problems and will have an important practical application should the time arrive when "light" is purchased as radiant power, just as electrical energy is purchased at the present day.

### Emissive Properties of Tungsten.

The emissive properties of tungsten were investigated by two methods. One investigation consisted in the determination of the selective reflection of plane, highly polished mirrors of tungsten in the visible and in the infra-red spectrum. A depression was found at 0.8 in the reflectivity curve, which is the cause of a marked selective emission band found in incandescent tungsten.

The second investigation was on the selective emission of straight and helical filaments of tungsten, in which it was shown that the increased brightness within the helix is due almost entirely to multiple reflection. The most important deduction is that the radiation from within the helix is not sufficiently close to that of a uniformly heated inclosure to be used in the calibration of pyrometers.

### Glasses for Protecting the Eyes from Injurious Radiations.

Attention has been called in previous reports to the importance of this subject, and during the past year data were published on the protective properties of typical glasses.

It will no doubt be understood that radiometry is the logical basis upon which to specify what constitutes ample protection from injurious radiations, whether ultra-violet or infra-red. At present information is quite lacking concerning the energy density and time of exposure necessary to produce injurious effects upon the eye.

#### **Photoelectric Properties of Various Substances.**

Conditions have arisen which make it desirable to determine the photoelectric sensitivity of substances in different parts of the spectrum, the energy measurements being made with a thermopile, which is a nonselective radiometer. Such an investigation is in progress and the results seem very promising.

#### **Information Furnished on Radiometric Subjects.**

In addition to experimental work, considerable information has been given in compliance with specific requests for information on radiometric matters, such, for example, as the radiative properties of materials suitable for covering radiators; the reflective properties of metals; Patent Office inquiries; standard sources of light; the effect of the heat of the moon upon plant life; thermal-radiodynamic signaling devices; selenium cells; the design of greenhouses to be maintained at a uniform temperature; and the application of radiometric methods to physiological and psychological problems.

#### **Publications on Radiometry.**

During the past year the following papers on radiometry were published: Technologic Paper No. 93, Glasses for Protecting the Eyes from Injurious Radiations; Scientific Paper No. 300, Emission of Straight and Helical Filaments of Tungsten; Scientific Paper No. 303, Relative Sensibility of the Average Eye to Light of Different Colors and Some Practical Applications to Radiation Problems; Scientific Paper No. 305, Luminous Radiation from a Black Body and the Mechanical Equivalent of Light; and Scientific Paper No. 308, Reflecting Power of Tungsten and Stellite. Experimental data were furnished for Scientific Paper No. 304, Calculation of the Constants of Planck's Radiation Equation: An Extension of the Theory of Least Squares.

### **5. CHEMISTRY.**

[Chemical composition and purity of material, chemical properties and constants, including researches upon methods of analysis, specifications for technical materials, and preparation of pure materials for standardization work for the Government and for industrial and scientific laboratories.]

#### **Rapid Electrolytic Determination of Carbon in Steel.**

The method developed for the rapid estimation of carbon in steel, referred to in the report for last year, has been improved and the results will soon be described in a forthcoming paper. The method is extremely rapid and seems to be well adapted for control work in steel plants; at the same time its accuracy is high. The carbon dioxide formed by burning the steel in oxygen is collected in a solution of barium hydroxide of known strength and conductivity. The resultant decrease in conductivity of the solution is a measure of the carbon burned.

### **Nitrogen in Steel.**

A direct method for determining gaseous nitrogen in steel has been devised and experimentally tested. The nitrogen (which may be admixed with any other gas or vapor that is free from nitrogen) is brought in contact with vapor of metallic calcium in a suitable apparatus and under reduced pressure. The nitrogen is immediately absorbed by the calcium as nitride. When this is dissolved in hydrochloric acid ammonium chloride is formed, and in this the nitrogen is determined by the usual methods. Experimental tests on synthetic mixtures were very satisfactory.

### **The Goeren's Method for Determining the Gas Content of Steels.**

The Goeren's method for determining the gas content of steels depends upon melting the steel mixed with metals which lower its melting point to a convenient working temperature, in an evacuated tube, and analyzing the gases evolved.

Much progress has been made in constructing the complicated apparatus required by this method, and when assembled the method will be given a thorough trial.

### **Determination of Gases in Steel by the Goutal Method.**

In pursuance of a plan to investigate sources of error in present methods for determining gases in steel and to originate new methods, if needed, the Goutal method was made the subject of study. This method consists in dissolving the steel in a solution of copper-potassium chloride in an apparatus which permits the gases given off during solution to be absorbed. Contrary to Goutal's conclusions, it has been found that the gas content thus obtained is an entirely fictitious one so far as concerns carbon monoxide and carbon dioxide, since these gases are generated by the oxidizing action of the cupric salt on the carbides present and there is, therefore, no relation between the observed percentage of these gases and the amounts actually present in the metal. A paper on this subject is in course of preparation.

### **Determination of Oxygen in Steel.**

A study of the Ledebur method for determining oxygen in steel has been completed and a paper on the subject is in preparation. This paper will contain results of tests for oxygen in a number of steels and irons by the Ledebur method, with special precautions to avoid all known or suspected sources of error.

### **Oxygen Content of Steels Deoxidizable in Various Ways.**

The improved Ledebur method referred to in the preceding section is being used to examine for oxygen content several heats of steel made (1) by ordinary commercial methods and (2) by variations of commercial practice with regard to deoxidation methods. The results of this investigation will be embodied in a paper.

### **Ladle Ingot Test Investigation.**

The work begun a year ago on ladle ingots has been continued and four sets of ladle test ingots made in molds typical of American practice have been cast under uniform conditions of customary prac-

tice at two steel plants. Two sets were of "rising" steel and two of "nonrising" steel. To the former aluminum was added in the mold at the time of pouring and the effect was to produce physically sound steel. All these ingots are being examined metallographically and later will be tested chemically for segregation.

#### Preparation of Iron-Carbon Alloys.

The general problems relating to the preparation of alloys of iron and carbon and the development of new alloy steels are discussed in the report of the metallurgical division. These problems involve much cooperation in research and testing on the part of the chemistry division.

#### Platinum Investigation.

It has been impossible to take up the extended research upon the chemical and physical properties of the platinum metals which was referred to in the report of last year, but provision has been made for beginning it during the coming year unless the exigencies of the war situation should make it expedient to postpone the work still further.

Several substitutes to replace platinum ware for chemical and physical uses have been proposed, and one of these has been submitted at the Bureau to a series of tests which show it to compare very favorably with platinum for most chemical uses. This is an alloy of 80 parts gold and 20 parts palladium. Alloys of quite different composition which have been submitted for test or soon will be submitted may prove suitable for use in other ways but are not likely to find extended use by chemists.

The New York assay office, continuing its cooperation of the past year, has made for the Bureau over 20 crucibles and a few miscellaneous articles of platinum which have given satisfaction. It is hoped that the Government laboratories generally will soon be able to draw their supplies from this source.

#### Variation of Commercial Gases from Boyle's Law.

The variation of natural gas from Boyle's law is of sufficient importance to introduce important differences in the apparent volume of gases measured at high pressure, as, for example, in connection with orifice meters, proportional meters, and other commercial metering equipment. At the suggestion of the Bureau, a means for taking account of this variation has been tried out in practice by certain natural-gas engineers and considerable success is anticipated in the further application of this method for correcting for the variation in compressibility of the gas from the theoretical values.

#### Specific Gravity of Gases.

The work reported a year ago on the specific gravity of gases has been continued and the specific gravity balance devised at the Bureau has been given field trials and certain improvements indicated as desirable have been made. The perfected apparatus has been constructed for use by a considerable number of natural-gas companies, and these are employing it regularly in their laboratories. Arrangements have been made for marketing this balance by one of the makers of physical-chemical apparatus, and the number of requests

for information on the subject indicates that wide application of the instrument is to be expected. The full investigation and its results are reported in Technologic Paper No. 89, A Specific Gravity Balance for Gases.

The closely related work on the effusion method for specific gravity determination has also been carried to a very successful conclusion and a report on this work has been made in Technologic Paper No. 94, Effusion Method for Gas Density. The theoretical aspects of this work have been developed in cooperation with one of the other divisions of the Bureau and a paper covering the conclusions is practically completed. This theoretical consideration of the subject has demonstrated the relation between the various properties of a gas and its apparent specific gravity as determined by the effusion method with apparatus of different characteristics. A most interesting theoretical development is that the effusion phenomenon is one of stream-line flow and not a molecular phenomenon as ordinarily believed.

#### **Preparation and Properties of Hydrogen.**

Additional determinations of the heat of combustion of pure hydrogen have been made, but until the heat division of the Bureau can give more time to this subject, little progress can be made in the preparation and the study of the properties of pure gases. It is inadvisable to begin work on carbon monoxide and carbon dioxide until the work on hydrogen has progressed further.

#### **Balloon Gas Investigation.**

At the request of the Signal Corps and of the Navy Department the Bureau is investigating methods for the generation of hydrogen, making certain tests of the materials from which this gas will be generated and cooperating in the drafting of instructions for the personnel which will operate and maintain the field and service equipment. This work will include study of hydrogen generation and compression and the filling of balloons, both to prevent explosions and to maintain the highest operating efficiency feasible under service conditions.

#### **Combustion Gas Detectors.**

An important research, in cooperation with one of the other divisions of the Bureau, on detectors for combustible gases has led to results of importance. Four types of detectors have been perfected which are suitable for various locations and uses. The type recommended to the Navy Department for use on submarines has proven so satisfactory in tests at the Bureau and the Brooklyn Navy Yard that it has been adopted for use on certain vessels. A report on this subject has been requested by and made to the naval authorities of Great Britain and Italy on the types of detectors specially recommended for naval use.

The question of the application of these devices for the detection and determination of carbon monoxide in the air has also been considered, but it is doubtful if the practical apparatus for use outside the laboratory can be made sufficiently sensitive to detect less than 0.1 per cent of carbon monoxide, which is the maximum quantity

that is considered safe to permit in the atmosphere where persons are working.

#### **Chemical Work on Balloon Fabrics.**

At the request of certain branches of the Navy and War Departments, the Bureau undertook to make tests on the permeability of fabrics for balloon construction to hydrogen and other balloon gases. This work indicated at once the need for more precise information than was available as to methods of permeability determination, the significance of these tests, and for other work on balloon fabrics. As an outgrowth of this testing the Bureau has undertaken an extended investigation of testing methods, life test on fabrics, and the improvement of fabrics in order to increase their life or to improve them in certain characteristics.

As a result of this work there has been developed a tentative specification for characterization of fabrics, covering permeability, weight, and strength, and including methods for performance of tests to determine compliance with these specifications. These will supersede other specifications that contained certain requirements which seemed impossible of interpretation or were meaningless and will probably make possible more satisfactory relations between the Government and the makers of these fabrics. The tests on permeability are almost completed, so that it is now possible to define with considerable accuracy the relation between tests under one set of conditions and those under another set and to eliminate the uncertainty in the significance of these test results.

The exposure test planned to determine the life of fabrics includes heating, exposure to light and radiation, exposure to weather, and comparison with actual service tests of the fabric in aircraft. The test involves experiments on glues and protective coatings for both balloons and other aircraft. The cooperation of manufacturers, the Signal Corps of the Army, and the Navy Department in this work will make the results of wide interest and value.

#### **Chemical Work on Refrigeration Problems.**

The work on refrigeration problems has made satisfactory progress and will be continued the coming year unless interrupted by more urgent demands in other directions. This work has involved the preparation and testing of pure materials and the study of gas formation in ammonia refrigeration systems. Specifications for anhydrous liquid ammonia have been prepared, and a report has been made on methods of testing and the composition of commercial samples.

#### **Chemical Work on the Standard Cell.**

The standard-cell work has developed in such a way that it has been possible to furnish practical results in the construction of standard cells, which are necessary and very difficult to obtain in the market.

A series of Clark (zinc) cells was prepared in August, 1916, which show great constancy. They were set up with the special object of avoiding gas formation and the cracking of the amalgam limb. A paper on the subject is now in preparation.



A considerable number of unsaturated cadmium cells have been prepared for the purpose of meeting the public demand, in view of the inability of manufacturers to supply them under present conditions. Such cells are quite necessary in work depending on high-temperature measurements and are essential in the prosecution of certain phases of war work. The results accumulated will form the basis for several papers.

#### **Electrotyping and Electroplating Investigation.**

Largely as a result of the work conducted by the Bureau upon the use of American ozokerite, there has been placed upon the market molding wax which appears to be satisfactory for electrotyping. This has not yet, however, come into extensive use, owing in part to the difficulty of adapting any one mixture to the variable conditions existing in different establishments.

During the year some progress has been made in cooperation with the electrical division upon the study of the conductivity of copper solutions. The results indicate, however, that there is a need for an extended and fundamental investigation of the methods of determining the conductivity of such solutions.

It is hoped to make more rapid progress upon some of the specific electrotyping problems during the next year through the cooperation of the International Association of Electrotypers, who have agreed to pay the salary and traveling expenses of a chemist to work upon their problems at and under the direction of the Bureau.

No definite progress has been made in the general study of electroplating problems. Numerous requests for information and for tests have come from the public and from Government departments. One of the most pressing needs in this industry appears to be the formulation of specifications for various kinds of plating, based upon chemical and metallographic examination, and possibly upon accelerated corrosion tests, such as, for example, the "salt spray test." In most cases, however, intelligent formulation of such specifications will involve a more or less detailed study in plant and laboratory of the conditions affecting the properties of the deposits.

In order to make such investigations at the Bureau on a semi-commercial scale, a plating laboratory is now being installed, provided with a 3-kilowatt generator and a number of small stoneware tanks. As the work progresses it will be necessary to increase this equipment to include apparatus for cleaning the articles and for polishing the deposits, etc.

With the present staff assigned to this work, it will probably be possible to study the above and any other plating problems of military importance likely to be referred to this Bureau. Rapid progress upon the more general and fundamental problems of electroplating will, however, require additional assistance.

#### **Renewal of Work on Various Analytical Problems.**

Arrangements have been made to renew the work on various analytical problems undertaken some time ago but discontinued because of press of work in other fields. Among such problems are the study of volumetric standards, the analysis of phosphate rock, and the study of the quality of reagents. The latter subject is now

so urgent that the American Chemical Society has taken steps to secure the active assistance of the Bureau in this work. It is recognized that with the limited force available under present abnormal conditions it will not be possible to make very rapid progress on these problems.

### **Paint and Varnish Investigations.**

A number of investigations on paints and varnishes have been conducted during the past year in cooperation with a committee of the American Society for Testing Materials, some of which are the practical testing of varnish; a study of unusual drying oils (Lumbang and Perilla); a determination of foots in linseed oil; a determination of the flash points of paint thinners; specifications for paint pigments; the preparation of standard methods of analysis of paint materials; and others.

A large number of service tests of paint and varnish was made for the federal General Supply Committee.

A convenient color scale of varnishes has been devised by making use of solutions in strong sulphuric acid of varying amounts of potassium bichromate.

A circular of information on paint and varnish, giving descriptions of raw materials, methods of manufacture, and methods of application of paint and varnish has been prepared for publication.

A satisfactory formula has been evolved for a paint that should be extremely white, dry flat, and adhere to cement, wood, or cloth surfaces.

An important line of work that should be taken up is that of field tests. This comprises the systematic study of various paint materials by inspections of painting operations on large scales in various localities, and of occasional check panels of similar materials made at the Bureau.

### **Nonferrous Alloys and Coated Materials.**

The major part of the work on nonferrous alloys and coated materials has been confined to routine testing of material for the Panama Canal and the Supervising Architect of the Treasury Department.

More or less research was involved in the following items: Study of the efficiency of the Parker Rust Proof Process to prevent corrosion of iron and steel; work on metal lathing in connection with the Bureau's stucco investigation; testing of fusible boiler plugs; examination of a failed fuse box cover from a locomotive in the Canal Zone; analysis of copper for an industrial concern; analysis of copper cable for the Argentine Naval Commission, and a determination of the zinc coating on galvanized wires. Of three methods used in connection with the last problem, namely, the antimony-hydrochloric acid method, the lead acetate method, and stripping in dilute sulphuric acid with correction for iron dissolved, it appears that the second and third yield results that are in fairly close agreement, while the first gives results which are too high.

A comparative corrosion test on brass and monel metal confirms commercial experience that the monel metal ordinarily gives better satisfaction.

At the request of the War Department, tests were made to determine the comparative durability of certain sherardized and electrogalvanized steel castings. Samples prepared by four companies were tested by the "salt spray" method. The tests showed the electrogalvanized samples to be superior to those that were sherardized.

#### **Bituminous Materials.**

The work on bituminous materials has developed materially. The number of samples has increased and those of new type are being submitted which require the development of special methods of testing.

About 400 samples of the important brands of roofing and waterproofing felts from about 40 manufacturers have been received and filed for reference, both as an aid in identifying these materials and to enable the Bureau to keep in touch with what is to be found on the market. The samples will also prove of value in passing on prepared roofings to be used on the various cantonment buildings recently constructed or under construction. The office of the Quartermaster General, United States Army, requests that the Bureau should be familiar with all of these materials. After these roofings have been in place a year or two they will be inspected, and it is believed that much valuable information will be gained.

Samples of authentic tars from various sources have been obtained from which it is proposed to distill creosote oils. These oils will then be studied as authentic oils to serve in grading oils that are received for test. It is also planned to ascertain whether or not the Forest Service method of distillation produces an undue amount of "cracking" of the oil.

Arrangements have been made to study a number of samples of "ship's insulating felt," known commercially as "Irish felt," with the object of developing a satisfactory specification.

The melting point of asphalt has been the object of some study and the ring and ball method of determining it, since adopted as standard by the American Society for Testing Materials, has been submitted for the cube method in an air bath.

A representative of the Bureau visited the asphalt lakes in Trinidad and those in Bermudez State, Venezuela, and gathered much information that will be of value in testing the asphalts from these sources. The same representative returned by way of the Canal Zone, where materials in service which the Bureau had tested were inspected. The information so gained is of great value in determining the fitness of materials for this climate and for the uses to which they are put.

#### **Chemical Work on Cement.**

In addition to the regular routine work on cements, limes, and plasters, much work has been done in cooperation with the cement division in investigations of the chemical changes occurring in mortar and concrete when exposed to sea water, "alkali" waters, and under abnormal conditions. Further cooperative work is planned on the problem of drain tile disintegration in other than "alkali" waters. A number of concrete floor-hardeners were examined for the cement division preliminary to a more extended study of the use and utility of such materials.

### **Chemical Tests of Lubricants.**

The demand for tests of lubricants has been so very great during the past year that it has been impossible to take up the contemplated study of certain problems along this line. Cooperative work with the American Society for Testing Materials has continued in this direction.

### **Chemical Work on Leather.**

For some time physical tests of leather have been made at the Bureau and the need for chemical control has become evident. The chemical division is now engaged on this work and, in addition, the National Tanners Association is cooperating with the Bureau on the subject. A rapid and sufficiently accurate method for determining the specific gravity of leather has already been devised.

### **Chemical Analysis of Rubber.**

The method devised at the Bureau, referred to in a previous report, for the direct determination of rubber by combustion of the nitrosite involved many difficulties, even when compounds containing new rubber were analyzed. These difficulties have been overcome and it is now possible to obtain correct results even when reclaimed rubber and lampblack are mixed with new rubber. A paper describing the method is now in preparation.

The factors which influence the determination of rubber and an accelerated aging test are under investigation and have yielded preliminary results of promise.

The Bureau has assisted in the work of the Joint Rubber Insulation Committee and its method for the determination of total sulphur in rubber has been adopted by the committee as an alternative procedure.

### **Chemical Work on Paper.**

Hydrocellulose, in powdered form, prepared from waste parchment paper, has been purchased and used as a filler instead of the clay and other mineral matter commonly used. Samples of paper made at the Bureau were tested in a wet plate press and gave excellent results.

A form of colloidal cellulose, not described in the literature, has been prepared. It is hoped to use it as a sizing for paper.

Work has been started, and is still in progress, on paper containers to be used as substitutes for tin cans. A bulletin on this subject has been issued jointly with the Bureau of Foreign and Domestic Commerce.

There has been considerable demand for Technologic Paper No. 87, describing the method for recovering pulp and paraffin from scrap paraffin paper.

An investigation of the precipitation of rosin sizing, after considerable progress had been made, had to be dropped temporarily because of more urgent work.

### **Tests of Chemical Glassware and Procelain.**

Comparative tests of a number of brands of domestic and foreign glassware and porcelain for chemical use have been made and the results will soon be published.

### Standard Analyzed Samples.

Another great increase is shown in the demand for the Bureau's standard samples. The number called for during the fiscal year 1917 was 3,536, as against 2,697 in 1916, and 1,826 in 1915. The distribution was as follows: Irons and steels, 2,867; brass, 54; ores, 229; sodium oxalate, 139; naphthalene, 120; benzoic acid, 30; sucrose, 76; dextrose, 6; metals for melting points, 13; cement for testing sieves, 2. Six samples under the last two items are new and have been issued only during a part of the year. An Alabama iron sample is also new. Three steel samples have been renewed.

The rapid growth in the demand for the samples makes it increasingly difficult with the means at command, to replenish exhausted stock and to add to the list of samples. Hence, it happened more than once that considerable time intervened between the exhaustion and renewal of a sample. A special fund should be available for the purchase and preparation of materials, apparatus, and appliances.

### Chemical Testing.

Somewhat over 9,000 tests were made in the chemical laboratories of the Bureau during the year. They involved the following materials: Ferrous metals (irons and steels), 319; coated metals, 832; nonferrous metals and alloys, 912; material from electrotyping baths, 27; cement materials, 1,205; coal tars, asphalts, and saturated felts, 984; burlap and building paper, 53; linseed oil, turpentine and driers, 562; varnish and shellac, 495; red lead, white lead, and putty, 371; paint materials, 407; greases, 109; soaps, 203; nondrying oils and metal polishes, 130; lubricating oils, 431; inks and ink materials, 368; flax packing, 17; asbestos, 60; paper, 761; rubber, 281; sealing wax, 11; wools and textile materials, 121; miscellaneous, 382; total, 9,041.

The above tests were made for about 80 Government bureaus and establishments, including, practically, all the executive departments, and for States, municipalities, and private parties, as follows: Agriculture, 19; Commerce, 1,380; Interior, 152; Labor, 20; Navy, 293; Post Office, 346; Treasury, 2,462; War, 350; Panama Canal, 2,574; Government Printing Office, 680; General Supply Committee, 423; other Federal institutions, committees, and commissions, 65; State, municipal and other institutions and committees, 150; and private parties, 126.

### Miscellaneous Chemical Tests and Investigations.

Many miscellaneous tests of interest have been made upon a great variety of subjects and materials, in part as follows: "Glasso," a material intended to prevent clouding of wind shields and goggles by rain or mist; Columbian Spirits, recommended as superior to ethyl alcohol for analytical purposes, and found not to be as suitable for soap analysis as ethyl alcohol; "Safetch," a material said to be excellent for use on aluminum plates used in map printing; and similar preparations.

### Chemical Publications.

The following papers, circulars, and addresses emanating from the chemistry division have been published during the year or are nearly ready for publication: Technologic Paper No. 87, Recovery

of Paraffin and Paper Stock from Waste Paraffin Paper; Technologic Paper No. 89, A Specific Gravity Balance for Gases; Technologic Paper No. 88, Studies on Paper Pulp; Technologic Paper No. 94, Effusion Method for Gas Density; "Our analytical chemistry and its future" (Chandler Foundation lecture, Columbia University); "Determination of gas density," to be published in a technical journal; "Calibration of the gas interferometer," to be published in a technical journal; "Gas investigations of the National Bureau of Standards"; proceedings of the Sixteenth Annual Convention of the Wisconsin Gas Association, March 13, 1917; "Reducing matter extractable from filter paper," Journal of the American Chemical Society, volume 39, page 928, 1917; Technologic Paper No. 98, The Effects of Heat on Celluloid and Similar Materials; "Composition and testing of commercial liquid ammonia," Journal of the Society of Refrigerating Engineers, volume 3, page 30, March, 1917; Circular No. 25 (revised), Standard Samples—General Information; Circular No. 62, Specifications for and Methods of Testing Soaps; and Circular No. 69, Paint and Varnish Materials.

### **New Chemistry Building.**

Delays due to certain differences with the contractor for construction and inability to obtain certain materials for equipment and labor for installation made it impossible to occupy the new chemistry building early in 1917, as had been expected. The transfer of men and working equipment began in June and will be completed, it is hoped, before the end of July. The occupation is progressing under difficulties, for not all of the necessary piping and fittings are in place even now, but the transfer is rendered necessary by the pressing demands for the space now occupied by the chemistry force in four other buildings.

The additional emergency appropriation of \$35,000 recently provided will probably permit the whole building to be fully equipped. However, the equipment installed thus far provides no more than for the present force of chemists, which is being rapidly increased to meet the needs of the war situation.

### **6. ENGINEERING RESEARCH AND TESTING.**

[Operative efficiency of mechanical appliances, accuracy of engineering instruments, conditions affecting their effective use, e. g., structure and design as related to durability and efficiency; methods of standardization and test, standards of performance, and fundamental researches on the scientific principles involved in speedometers, pressure gauges, water-current meters, anemometers, tachometers, gasoline and other motors, propellers, and other airplane parts and materials, etc.]

### **Water-Current Meter Rating Stations.**

One of the most important engineering services rendered by the Bureau is the furnishing of accurate calibration of current meters. These instruments are used by civil and hydraulic engineers in the measurement of the velocity of flowing water in rivers, irrigation canals, and other open channels, to secure data for the computation of the quantity of water discharged through such channels in a given time, data necessary in the development of the water resources of the country in power development, irrigation, flood prevention, and similar projects. To secure accuracy in these measurements, the instruments must be calibrated from time to time. A

body of still water must be available for this purpose, together with equipment for towing the instrument through the water at different uniform speeds and for accurately recording the observations.

Adequate installations of this character are costly and are necessarily confined almost entirely to Government stations and large university laboratories, which are not always available for this purpose. In the new rating station designed and constructed by the Bureau especially for this work, exceptional facilities are afforded for the calibration and study of these instruments. Since the entire flume was housed in a year ago, the station is in continuous operation throughout the year. While a majority of the ratings made are for the different engineering bureaus of the Government, this service is also performed for engineers in private practice, a rating curve and table being furnished for a nominal fee.

During the past fiscal year 277 current meter ratings were made. Of this number 203 were for the Government departments and 74 for engineers outside the Government service. The latter figure shows an increase of about 80 per cent over the number for the previous year. A number of special tests were also made, including tests of six meters of a new type for an instrument manufacturer, a special rating for the Canadian Geological Survey, and tests of meters for research work by Government bureaus.

#### **Different Forms of Cable Suspension for Current Meters.**

In making measurements of current velocity in deep streams, the current meter is suspended from a cable on a hanger, to which are also attached weights of a standard form to keep the cable in an approximately vertical alignment. The number and size of weights used vary for different conditions met in the field. At the request of the United States Geological Survey, an investigation was conducted of the deviations from the rating made with its standard form of cable support, produced by each of several arrangements of weights commonly used in the field differing from the ordinary standard in the size of weights and in their position on the usual strap hanger relative to the meter.

Factors were obtained by means of which the standard rating table can be used without a special rating of the meter for each particular case. The results of this investigation have been embodied in a circular issued to its field engineers by the Geological Survey. This investigation has been extended at the request of the Geological Survey to obtain similar data for new equipment which has recently been adopted for field use.

#### **Depth of Submersion of Current Meters.**

An investigation has been in progress to determine the effect of the depth of submersion on the rate of rotation of the small Price current meter. Tests have been made for depths of from two-tenths of a foot to 2 feet for velocities from one-half foot to 6 feet per second. This work has been practically completed. The results thus far obtained indicate that for the same velocity the rotation of the meter is in general increasingly retarded as the meter approaches the surface, but that this effect practically disappears at depths greater than 1 foot.

### **Fire-Extinguisher Investigations and Tests.**

A report has been made to the Steamboat-Inspection Service, embodying the results of an examination and test of 75 different makes of hand fire extinguishers, in compliance with a request from that Bureau. Included in these different makes were extinguishers of the dry powder, soda and acid, and carbon-tetrachloride types. The various devices submitted have been classified and the limitations and particular fields of service of each type have been outlined. Each extinguisher was tested from the standpoint of safety and reliability in operation and effectiveness as a first-aid fire appliance.

The Steamboat-Inspection Service has been furnished with data for use as a basis for the future approval of devices of this character used on vessels under its jurisdiction. As a result, a number of extinguishers which do not embody the most modern practice in the construction of these devices will not be included in the list of approved extinguishers. It was found, for example, that a large proportion of the small hand extinguishers which use extinguishing fluids consisting principally of carbon tetrachloride were, owing to their principle of operation or defects in their construction, unreliable and not suited for first-aid fire-extinguishing purposes.

The testing of extinguishers which have been submitted since the first report was made and the retest of those which have been modified since the first tests and resubmitted is still in progress.

A more extended investigation of several types of fire extinguishers with especial reference to their use on vessels has been planned for the coming year.

Advice has also been furnished to other Government bureaus in connection with the purchase of fire extinguishers.

### **Fire-Extinguishing Equipment for Wooden Submarine Chasers.**

At the request of the Navy Department, the Bureau is investigating the subject of fire protection for the engine compartment of wooden submarine chasers. The unusual conditions to be met on board these small wooden vessels introduce a fire hazard requiring special fire-extinguishing equipment of the most reliable and efficient type. The problem is being studied in the light of all available data on the subject and experiments are being conducted to determine the kind of fire-extinguishing equipment that is best suited for the purpose.

### **Radiator Traps Used in Vacuum Heating Systems.**

The testing of different makes of radiator return line valves, undertaken at the request of the Supervising Architect of the Treasury Department, has been continued. These valves are used in vacuum heating systems. One of these devices is installed at the outlet of each radiator in such a system, its function being to keep the radiator at maximum temperature by the continuous removal of the air and water of condensation, and to prevent the escape of uncondensed steam into the return pipe. The economical and satisfactory operation of a heating system of this character is largely dependent on the successful operation of these valves. Thousands of these devices are annually installed by the Treasury Department in public buildings under its control. Samples of the greater number of the many



valves of this character on the market have been tested. Data have been secured to determine a standard of performance for these devices and to enable the Government to select for its use the best valves available.

### **High-Pressure Gauges.**

While inexpensive apparatus for the checking of pressure gauges for the measurement of the ordinary range of working pressures is available, the same is not true for pressures in excess of 1,000 pounds per square inch. During the past year, the Bureau has been called upon to calibrate 22 of these instruments designed for maximum pressures from 1,000 to 30,000 pounds per square inch. This service was performed principally for gauge manufacturers and munition makers.

### **Sounding Tubes.**

A series of tests were made for the Coast Survey to secure data for establishing a scale for a new form of sounding tube being developed by that service.

### **Spirits Meter.**

A series of tests were made for the Internal Revenue Service of a new type of meter for the measurement of distilled spirits to determine its suitability for customs purposes.

### **Patrol Lanterns for the United States Coast Guard Service.**

Tests were made for the Treasury Department to determine the effect of high wind velocities on 12 different types of patrol lanterns for use by the Coast Guard service. The tests were conducted in the wind tunnel at the Washington Navy Yard, where it was possible to subject the lanterns to wind velocities up to 60 miles per hour.

### **Gasoline Intensifiers for Automobile Engines.**

There are a number of materials on the market known as gasoline intensifiers, for which the claim is made that when added in small quantities to gasoline, an increased engine efficiency is secured. Six of these materials were tested with a six-cylinder automobile engine driving an electric absorption dynamometer, and a sample of gasoline alleged to be treated by a secret electrochemical process was tested in the same way. The apparatus used was very sensitive and capable of indicating small differences in power developed, but in no case was there any noticeable increase in power or efficiency of the engine when using the treated gasoline as compared with its performance when using straight gasoline under the same operating conditions.

### **Miscellaneous Tests of Instruments and Devices.**

The routine tests of the engineering instrument section amounted to 439, including 277 current meters, 22 high-pressure gauges, 64 pressure and vacuum gauges, 10 anemometers, and 66 miscellaneous tests of instruments and devices, including tachometers, indicators, air pumps, fire extinguishers, valves, paper testers, speedometers, etc.

### **Cooperation with Scientific and Technical Societies.**

The Bureau is cooperating with the National Fire Protection Association in developing standard requirements for the design and installation of automatic sprinkler equipments, including "dry pipe" systems which are used in buildings when the temperature falls below the freezing point of water, and chemical sprinkler systems in which liquids other than plain water are used as the extinguishing agent and whose operation involves chemical reactions. The Bureau is also cooperating with this association in establishing standard specifications for pipes and pipe fittings, and in encouraging the general adoption of the National Standard Fire Hose Couplings. A revised edition of Circular No. 50, National Standard Hose Couplings and Fittings for Public Fire Service, has been published and there is evidence that municipal fire departments throughout the country appreciate more fully than ever before the advantages of fire-fighting equipment that is made interchangeable by the use of standard connections.

### **Investigations Relating to Mechanical Appliances.**

The investigations summarized under the following topics are illustrative of a general type relating to mechanical appliances, which are now carried out in several divisions of the Bureau, but which will probably be combined into a new section of work relating to mechanical appliances.

#### **Spark-Plug Investigations.**

Work has been done in cooperation with the electrical division and with the Pittsburgh laboratories of the Bureau in an investigation of the causes of failure of ignition spark plugs in aeronautic engines, with a view to remedying the difficulties.

Study of the behavior of many different makes of spark plugs, both by laboratory experiments and service tests in an aeronautic engine, have in part led to the preparation and adoption of acceptance specifications by the Signal Corps. Tests are being made under these specifications at the Bureau.

Test samples covering the whole range of possible porcelain composition, have been made up at Pittsburgh and are being tested for their thermal and electrical behavior.

Arrangements have been made for the construction of spark plug porcelain from the most promising of these compositions.

The temperature conditions to which spark plug porcelains are subjected are being investigated by direct temperature measurements in actual service with a view to devising means to meet satisfactorily the conditions of high temperature and extreme temperature gradients which occur in aeronautic engines.

#### **Aeronautic Radiator Investigations.**

Work was started in May on an investigation of the relation between the geometric form of radiator cells and the cooling capacity and head resistance of radiators under varying conditions of air velocity and air pressure.

The program includes (1) a study of the fundamental laws of air flow and heat transfer in cellular types of radiators by means of

measurements on all typical radiators now in use and other forms, which are necessary to complete the series of practicable cell dimensions; (2) application of the results to the design of radiator cell dimensions for maximum efficiency under various conditions of pressure and velocity; and (3) the establishment, if possible, of designs for standard radiator units which can be readily built and made interchangeable.

Equipment for this investigation, including a miniature wind tunnel with a section 20 cm. square, built within a vacuum chamber, has been substantially completed.

### **Installation of Aeronautic Engine Testing Laboratories.**

In cooperation with the Signal Corps, the Bureau has built a dynamometer laboratory comprising equipment for the testing of aeronautic engines up to 400 horsepower by means of an electrical dynamometer. A separate installation for running service and endurance tests of engines of practically any output is also under construction. In this latter installation, the engine is connected to a test propeller to permit the taking of observations on the effectiveness and durability of various devices and auxiliaries under service conditions. In both of these plants provisions were made for an accurate study of engine performance, by the application of means for measuring power output, fuel input, speed, heat balances, etc.

The object of this equipment is to provide a means of studying the fundamental elements of the design and operation of aeronautic engines with the immediate view of eliminating minor operation difficulties and improving the construction of aeronautic power plants, by furnishing reliable and accurate data.

One of the points to be determined by investigations of this character is the maximum compression ratio that can be used with safety in practice (this quantity determines the maximum power output that is attainable with a given type and size of engine). This work requires an exact knowledge of the behavior of spark plugs and ignition devices, as well as accurate measurements of the amount of heat which must be taken care of by the radiator system. Another important problem is the design of the radiator itself, an investigation of which is being made in cooperation with the National Advisory Committee for Aeronautics. The data hitherto available regarding the heat-dissipating capacity of given radiator designs, have been inadequate to give designers a sure basis upon which to work. Another is the problem of proper lubrication of the aeronautic motor, both as to quantity, quality, operating characteristics, and the oils to be used, including the temperature at which those oils may be safely run. Still another is the effect of various fuels and carburetion systems and of different designs of intake and exhaust manifolds, all of which have a marked effect on the efficiency and reliability of the aeronautic power plant.

### **Testing of Aeronautic Engines Under Conditions of Reduced Atmospheric Pressure.**

In cooperation with the subcommittee on power plants of the National Advisory Committee for Aeronautics, the Bureau is building a laboratory for the testing of aeronautic engines under conditions of reduced atmospheric pressure, in order to determine among other things, the effect of different grades of fuel with respect to the

variations of atmospheric air pressure encountered under conditions of actual flying. It may be that for high altitude service considerable improvement in power, climbing ability, and speed can be obtained by the use of special fuels. The same laboratory will serve for testing out other methods and appliances, such as carburetion accessories, which have been proposed for increasing the power output at high altitudes. All of this work is of the utmost military significance.

### **Liberty Engine.**

Since the middle of June, the design work on the Liberty Engine, which is to be produced on a large scale for use on American-made airplanes, has been temporarily quartered at the Bureau of Standards. All divisions of the Bureau have cooperated to the fullest extent in supplying technical information of every character and, where necessary, have conducted investigations to aid in the production of this motor.

## **7. METALLURGY.**

[Thermal analysis and structure of metals, heat treatment and its effect upon the properties of metals and alloys, including the researches involved in determining the causes of metal failures, cooling and heating curves; the investigation of hardening, annealing, tempering, cementation; the determination of critical ranges; and the preparation of pure metals and alloys.]

### **Railway Materials Investigations.**

The main outstanding rail problem from the standpoint of safety in railroad practice is that of the prevention of transverse fissures. The work of the past year has been directed in a number of ways toward the determination of the nature and causes of such fissures.

A number of fissured rails furnished by various railway companies have been thoroughly studied and reported to the companies; the investigation included physical, chemical, and metallographic examination.

More work has been done on the distribution of temperature in cooling rails of different sections, as throwing light upon the behavior of rails upon the hot beds.

A study has been made of the steel at various parts of the head of fissured and normal rails in order to detect any evidences of lack of thermal equilibrium (delayed transformation) which might account for the brittleness usually associated with the steel at the center of the head of fissured rails. This study included determinations of density, thermal analysis, and microscopic examination. Determinations of the coefficients of thermal expansion at various locations near a fissure has failed to indicate any significant variations.

The investigation to date indicates that none of the ordinary characteristics, including structure, expansion and chemical analysis of fissured rails (except possibly the mechanical properties), exhibit any variation from the normal condition in which cause might be sought for the abnormal service behavior of the rail.

### **Chilled Car-Wheel Investigation.**

Measurement has been made of the stresses developed in the plate of the three standard master car builders wheel (625, 675, and 724 pounds) by heating of the rim or tread of the wheel. Such heating

in service is produced by the friction of the brake shoe on the wheel tread and leads to numerous wheel failures by the cracking of the plate. The present investigation will furnish information regarding the magnitude and distribution of such stresses in different weights and designs of wheels and should be a basis for rational alterations in such weights or design as may later be undertaken through the proper associations. Stresses were produced in these tests equal to 20,000 to 24,000 pounds per square inch; these are close to the ultimate breaking strength of the cast-iron of the wheel plate.

Work is being continued on the annealing characteristics of cast-iron, particularly of car wheel compositions. This work is at present concerned with the effect of variation in sulphur and manganese content in the velocity and temperature of the decomposition of the white iron carbide. A paper is now in preparation dealing with certain phases of the analytical methods for the determination of carbon.

### **Iron-Carbon System.**

Several ingots of pure iron and of iron-carbon alloys have been cast in the new large vacuum furnace. These ingots have been forged, rolled, or drawn into shape for various physical measurements and supplied to other divisions of the Bureau or to outside laboratories for tests. Further thermal analyses have been made of the various carbon compositions. After the furnaces and transformer are moved to the new chemistry building, it is hoped that greater progress may be made in this work, and that several new phases may be taken up, including a study of the equilibria of systems other than the iron-carbon one. In this manner the effect on steel of different elements, such as sulphur, manganese, and phosphorus, may be studied under ideal conditions, including the elimination of the elements not being studied.

### **Second Ingot Investigation.**

The results of the tests made in cooperation with the Pennsylvania Railroad of rails manufactured from different types of ingots are in shape for the preparation of a published report. The results include determination of physical properties, microstructure, segregation, etc., and indicate the effect of type of ingot upon the finished rail.

### **Ladle Test Ingot Metallurgical Investigation.**

Work is being continued in cooperation with the chemical division, with a view to determining the best form of test ingot, as well as the amount of segregation which may be expected in steel ingots.

### **Gases and Oxides in Steel.**

The work on gases and oxides in steel should be extended as soon as the analytical methods are sufficiently adequate to include a thorough investigation of the effect of these impurities on the properties of steel. This will include also a study of the effect and efficiency of various commercial deoxidizers for steel.

The chemical features of this work, which include a study of the best methods for the analytical work involved in such investigations, are covered in the report of the chemical division.

### **Gun Erosion and Allied Phenomena.**

The Bureau has been asked several times by the War Department for information concerning certain aspects of the gun erosion problem, and therefore the Bureau has undertaken a preliminary laboratory investigation of the behavior of metals when very quickly cooled from high temperatures. It is believed that practical field investigation of this problem can be much aided by a laboratory study of those properties of different metallic materials which are concerned in their service behavior in the form of gun linings. This will involve a study of certain properties of these materials at high temperatures.

### **Temperature Measurements in Metallurgical Practice.**

Within the past three years studies have been made of the feasibility of temperature measurements in steel plants with particular reference to the measurement of rolling temperatures and those of the molten steel in the open-hearth furnace, in the Bessemer converter, and during pouring and teeming. It has been shown (see Technologic Paper No. 91) that the measurement and pyrometric control of furnace casting and ingot teeming temperatures present no serious difficulties or uncertainties. For this purpose the most satisfactory type of instrument is one of the special pyrometers using monochromatic light and permitting observations from a distance of streams of metal. For streams of liquid iron or steel, the most probable value of the emissivity to take, using red light ( $\lambda=0.65 \mu$ ), is  $e=0.40$ . The value of  $e$  for liquid slag is usually about 0.65, but it varies with the composition. Determination of the temperature of charge of Bessemer converters is not deemed practicable by such pyrometric methods. The temperature of the open-hearth bath is usually kept between  $1,600^{\circ}$  and  $1,670^{\circ}$  C.

### **Thermocouple Nichrome-Constantan.**

In connection with work on the distribution of temperature in a cooling rail, a study was made of the suitability of various materials for thermocouples operating up to  $1,000^{\circ}$  C. Tests showed that for immersion in steel at  $1,000^{\circ}$  C., thermocouple nichrome-constantan is very satisfactory. It maintains a calibration constant to within  $10^{\circ}$  C. at  $1,000^{\circ}$  C. throughout its life; the calibration curve is nearly linear and shows no departure from a smooth curve.

### **Failure of Brasses and Bronzes.**

During the year publication has been made of the results described in the report of last year on the subject of the failure of brasses and bronzes. In addition, the investigation of the thermal expansion of alpha and of beta brass has been completed, and progress is reported in the stress corrosion tests of manganese bronze.

The thermal expansion of beta brass, although at ordinary temperatures equal to that of alpha brass, is, at temperatures from  $400^{\circ}$  to  $450^{\circ}$  C., approximately 50 per cent greater than the latter. The beta grains in a rapidly cooled 60:40 brass containing both alpha and beta will be in a state of local tension, the alpha grains in compression. This initial stress may be responsible for subsequent failure and

cracking in failed brass bolts which have come to the attention of the Bureau and are known to have been quenched in water. It is shown also that these local stresses lower the proportional limit of a brass.

The samples of annealed manganese bronze subjected to corrosion in a water tank at the Bureau for over six months, while under tensional stresses equal to their proportional limits, have so far shown no signs of cracking, although slight corrosion has set in. These tests are to be extended and amplified.

#### **Corrosion of Brasses and Bronzes.**

Study has been made of the microstructural features of corrosion in cast bronzes and in wrought 60:40 brass of the type of Muntz metal. This work is being continued with the purpose of ascertaining the structural electrolytic potential differences and the effect of such differences upon corrosion. A study is also being made of the effect of stress upon corrosion. It is apparent from the metallographic studies made, both at the Bureau and abroad under the auspices of the British Institute of Metals, that the corrosion of brasses and bronzes is most intimately related to the features of structure.

#### **Impurities in Cast Bronze and Brass.**

An investigation has been undertaken of the specific effects of the usual impurities in cast brass and bronze upon its properties, chiefly physical—tensile, hydraulic, resistance, etc. The results of this investigation will indicate the extent to which scrap may be used in producing castings of these metals and will be a basis for establishing chemical specifications for them. Defects and failure of castings are frequently attributed to the presence of small amounts of impurities, which should, probably, more properly be attributed to improper foundry practice in melting and pouring the alloys.

#### **Properties of Commercial Cast Brasses and Bronzes.**

Numerous tests have been made at the Bureau's foundry of both 88:10:2 and 88:8:4 (copper-tin-zinc) metal cast into a form of test bar recommended by the Naval Gun Factory (Washington Navy Yard). This is a core sand cast, cast to size specimen fed along its whole length. This form of test coupon gives very uniform results for these medium shrinkage metals. These tests will be continued with the cooperation of five commercial foundries and with that of the Naval Gun Factory. The results will form a basis for the defining of specifications for the metals so tested.

#### **Foundry Sands.**

Comparison has been made of the mechanical properties of fine French facing sands and of American ones used as substitutes for these. It has been shown that one or two American sands are equal to the imported French sands in every respect except that of tensile strength. Samples made up of the various sands have indicated that the tensile strength of the French sands is superior to that of the American ones. A report is to be made before the American Foundrymen's Association at its fall meeting.

### **Deterioration of Tinned Copper Roofing.**

The tinned copper roofs of certain buildings have, within some 8 to 10 years after installation, become quite badly pitted. Investigation showed that this pitting is primarily due to the structure of the tin coating. This coating, produced by the application of molten tin to the surface of the sheet, contains an alloy layer next to the copper which is slightly electronegative to it. Such a coating, therefore, gives only a mechanical protection; as soon as the copper is exposed, galvanic action sets in and the copper is attacked. Plain copper on some of the buildings had suffered no deterioration under the same service conditions. Tinned copper must be looked upon as a quite unreliable material for roofing purposes, inferior to plain copper, and in most cases inferior also to tin plate.

### **Properties of Electrolytically Deposited Copper.**

A preliminary report has been published of the studies of copper electrodeposition in electrotyping baths. These studies have resulted in establishing tentative specifications for the deposition of such copper, concerning the composition of bath, current density, etc.

In connection with this work there has been published (*Transactions of American Institute of Metals*, 1916) an article, giving a description of the microscopic structure of electrodeposited copper. The occurrence and effect of twinned copper crystals or grains as deposited are discussed. The conclusion is reached that the grain size of such deposits does not alone determine the physical properties.

### **Protective Metallic Coatings on Metals.**

In connection with the general work on protective metallic coatings on metals, a report has been made giving a comparison of the basic lead acetate and the hydrochloric acid-antimony chloride methods of determining zinc on galvanized iron. This work is to be continued in the direction of comparative service tests (salt spray test) of zinc coating applied by different methods—sherardized, galvanized, and electrogalvanized.

### **Fusible Boiler Plugs.**

Further investigation has been made within the year of the mode of introduction of impurities, such as lead, copper, and zinc, into the tin fillings of fusible boiler plugs. The effect of heating the tin and the casing to different temperatures on the copper content of the filling has been determined, and manufacturers have been advised of these results in order that they may meet the Steamboat-Inspection Service specifications.

### **Melting Points of Refractory Elements.**

Several additional determinations have been made of the melting points of the most refractory elements, chromium and manganese, and apparatus assembled for the completion of the work. The melting points of some 140 steels of different composition have also been determined by optical pyrometer methods.

### **Cooperation with Military Government Departments.**

One of the features of the work of the metallurgical division has been its greatly increased contact during the last year, and particu-



larly during the past three months, with the military Government departments.

The Bureau is cooperating with the Bureau of Construction and Repair of the Navy Department and the Signal Corps of the War Department in an extensive investigation of light aluminum alloys for rolling and casting. It is hoped that alloys may be developed of greater specific mass tenacity than those at present in use.

The Bureau has been of some service in connection with the setting of certain Navy Department specifications for brasses.

Besides a number of routine tests for the Government military departments, this division has, often in cooperation with other divisions, conducted special investigations and investigative tests of very interesting character. Typical instances are corrosion of Muntz metal bolt, for Boston Navy Yard; examination of samples of Duralumin alloy used in Zeppelin construction, for Bureau of Construction and Repair, Navy Department; investigation of failed metal parts, for Signal Corps, War Department; examination and comparison of zinc coatings on shrapnel tinning leads, Office of Ordnance, War Department; cracking of steel rivets (submarine hull construction), for Bureau of Construction and Repair, Navy Department; identification tags of Monel metal for seamen, for Bureau of Identification, Navy Department.

#### **Cooperative Work in Metals.**

A feature of the work of the metallurgical division has been its method of cooperation with technical societies or industries in the prosecution of its investigational work. In this manner the work it undertakes may proceed upon the very broadest lines and with full pertinence to industrial practice.

A committee of the American Institute of Metals and other technical societies meets twice a year at the Bureau and discusses the Bureau's work in nonferrous metals.

Through the membership of its staff members in various committees of the American Society for Testing Materials it cooperates with this association in its standard work. Such committees are: The chilled car-wheel subcommittee; the subcommittee on preservative metallic coatings for metals; the nonferrous metals committee; and the subcommittee on the methods of analysis of steel.

It cooperates with five commercial and one Navy Department foundry in its investigation of the properties of commercial brasses and bronzes, with the Pennsylvania Railroad in its work on sound ingots, and with the Aluminum Co. of America in its investigation of light alloys.

#### **Activity in Technical or Scientific Societies.**

The results of the Bureau's metallurgical work have been presented in papers and discussed before the following societies: American Chemical Society, American Electrochemical Society, American Institute of Metals, American Society for Testing Materials, Iron and Steel Institute of Great Britain, American Foundrymen's Association, Washington Academy of Sciences, American Institute of Mining Engineers, and The Franklin Institute. Several members of the metallurgical staff are serving actively as officers or as members

of committees of those technical or scientific societies cooperating with the Bureau on metallurgical subjects.

### Metallurgical Tests.

A summary of the metallurgical tests is given below; their total value in fees is \$3,666.25. Of these test items, 94 per cent were for the various departments of the Government and 6 per cent for private individuals and corporations. Many of these tests were of a very important nature, involving considerable investigation and special installations, and some have served as starting points for special experimental research.

Name.	Heat treatment and thermal analysis.		Metallographic.			Fusible plugs.	Brass and bronze failure.	Miscellaneous.	Grand total.
	Irons and steels.	Non-ferrous metals.	Identification of metal and process of manufacture.	Metal failures.	Miscellaneous.				
<b>For the Government:</b>									
Bureau of Standards.....	88			1	17			20	126
Navy Department.....	13			9	25		2		49
Panama Canal.....	2		270	2	4	11		14	303
Steamboat - Inspection Service.....						547			547
Treasury Department.....		2			6			11	19
War Department.....			9	2	19			1	31
<b>Total.....</b>	<b>103</b>	<b>2</b>	<b>279</b>	<b>14</b>	<b>71</b>	<b>558</b>	<b>2</b>	<b>46</b>	<b>1,075</b>
<b>For the public.....</b>			<b>3</b>	<b>4</b>	<b>17</b>		<b>34</b>	<b>6</b>	<b>64</b>
<b>Grand total.....</b>	<b>103</b>	<b>2</b>	<b>282</b>	<b>18</b>	<b>88</b>	<b>558</b>	<b>86</b>	<b>52</b>	<b>1,139</b>

### Information Furnished to the Government and the Public.

Requests are constantly being received for information concerning metallurgical topics. Often these are of unusual nature and require much time in preparation. During the past year information on some 200 different topics has been furnished. In view of this, steps have been taken to prepare a comprehensive metallurgical bibliography and file of information to facilitate the preparation of replies to such requests.

### Circulars of Information on Metallurgical Subjects.

A rather extensive circular of information on copper has been prepared, dealing primarily with its physical properties, and with the effect of variations in composition and in the conditions of the process of manufacture upon these properties.

The circular on metals for pyrometric standards is in press.

Requests for information on certain subjects have been so numerous that letter circulars have been prepared; the following subjects have been covered or are being taken up: The "hardening" of copper; the heat treatment of steel; welding; brass and bronze; and light aluminum alloys.

### Metallurgical Publications.

The following metallurgical publications and special papers, most of which have been reprinted in foreign or American technical or scientific journals, have been issued during the year: Technologic Paper No. 91, Temperature Measurements in Bessemer and Open-Hearth Practice; Scientific Paper No. 296, Thermoelectric Measurement of the Critical Ranges of Pure Iron; Technologic Paper No. 82, Failure of Brass: 1, Microstructure and Initial Stress in Wrought Brasses of the Type 60 Per Cent of Copper and 40 Per Cent of Zinc; Technologic Paper No. 83, Failure of Brass: 2, Effect of Corrosion on Ductility and Strength of Brass; Technologic Paper No. 84, Failure of Brass: 3, Initial Stress Produced by the "Burning-in" of Manganese Bronze; Technologic Paper No. 90, Structure of Coating on Tinned Sheet Copper in Relation to a Specific Case of Corrosion; "The embrittling action of sodium hydroxide on mild steel," published in *Metallurgical and Chemical Engineering*, May, 1917; "Notes on the thermocouple nichrome-constantan," published in *Metallurgical and Chemical Engineering*, June, 1917; "Some problems in physical metallurgy at the Bureau of Standards," published in the *Journal of the Franklin Institute*, July, 1916; "Note on the occurrence and significance of twinned crystals in electrolytic copper," published in *Transactions of American Electrochemical Society*, 1916; "Preliminary studies in the deposition of copper in electrotyping baths," published in *Transactions of American Electrochemical Society*, 1917.

There are also in press or in course of preparation papers on the following subjects: Thermal expansion of alpha and beta brass; copper; some unusual features in the microstructure of wrought iron; typical case of the selective corrosion of Muntz metal; comparison of basic lead acetate and the hydrochloric acid-antimony chloride method for determining zinc coatings on sheets and wires; preliminary report on fine-facing molding sands; determination of oxygen in steel; determination of gases in steel; determination of cadmium in brass; and determination of graphite in cast iron.

A number of investigations have been concluded within the past year or brought to such a state as to warrant soon the publication of results.

### 8 STRUCTURAL, ENGINEERING, AND MISCELLANEOUS MATERIALS.

[Strength, hardness, elasticity, plasticity, permeability, composition, structure, and other physical and chemical properties of structural and miscellaneous materials, such as cement, stone, clay, lime, paper, textiles, rubber, etc., including laboratory and field work in developing methods of test, standards of quality, and the relation of quality to the efficient utilization of such materials.]

#### Investigation of Structural Steel Columns.

An important investigation on the strength of steel columns has been conducted for the past few years in cooperation with committees of the American Society of Civil Engineers and the American Railway Engineering Association.

The columns comprising the series investigated for the American Society of Civil Engineers were designed primarily to study the effect of cross section. Nine different types were fabricated in both light

and heavy sections. The original series as outlined comprised three different lengths of each type and three columns of each length in both light and heavy sections. This program was later extended to five different lengths for certain of the types and three different weights of material.

The series tested for the American Railway Engineering Association were designed primarily to study the effect of lattice bars and batten plates, as well as different end conditions. In this series both light and heavy sections, each with three different lengths and three columns for each length were tested.

The work of testing of the columns of these two series was completed during the year, and reports on the tests were furnished to the committees of the two societies.

An exhaustive program has been outlined with a view to determining the quality of the metal from which the columns were fabricated. The results obtained to date on this supplementary program seem to account for some of the rather startling results obtained on the columns tested. This supplementary program is about one-third completed.

This investigation, comprising a total of 240 columns, is the most comprehensive investigation that has ever been undertaken on the strength of steel columns and the results obtained therefrom will be of great value to engineers and architects as soon as the results become available.

The publication of preliminary reports of the results of these investigations have appeared from time to time in the proceedings of the respective societies as progress reports. Work is now under way for the publication of a final report of these committees on these investigations during the coming year.

During the past year the Bureau has received 233 steel columns by transfer from the Watertown Arsenal. These represent columns purchased in 1908 for an investigation originally intended to be conducted at that place. The work of testing these columns has been postponed until the results of the series just completed may be thoroughly studied.

### **Physical Investigations of Railway Material.**

The work done during the past year on railroad materials has been that of investigating the cause of failure of rails previously submitted by various railroad companies. This investigation has included the determination of the physical properties of various parts of the rail, as well as tests on complete heads, webs, and bases. In connection with this work, the division has had the cooperation of the chemical and metallurgical divisions in chemical analyses and microscopic examinations. A number of rails have thus been investigated and reports of these investigations with conclusions have been furnished the various railway companies interested.

In addition to a study of the physical, chemical, and metallurgical problems, as usually made, a preliminary study has been made on the distribution of internal stresses in the various parts of a rail. A sufficient amount of work has not as yet been done to warrant the drawing of any definite conclusions.

### Investigation of the Physical Properties of Zinc.

The investigation on the physical properties of cast zinc has been carried on during the past year upon material submitted by a commercial company which represents exceedingly pure zinc, and material submitted by another company which represents a grade of zinc containing considerably greater impurities. The investigation comprised tensile, compressive, torsional, cold bend, and hardness tests. This investigation has been very illuminating in regard to the effect of small quantities of impurities in zinc. The zinc representing the pure material was found to be almost entirely devoid of elastic property, while the zinc containing some impurity showed considerable elastic property. It is hoped to extend this investigation to comprise other pure metals, and the results obtained will be published as a technologic paper.

### Investigation of Methods of Calibration of Testing Machines.

During the early part of the year considerable work was done on the ways and means of calibrating testing machines up to full capacity and some very satisfactory results were obtained. Three methods are being investigated to determine their relative merits, namely: (1) The adaptation of the hydraulic support in combination with a suitable portable registering device; (2) calibration of vertical testing machines by the substitution method; and (3) the use of a series of standard bars of different sectional areas, in conjunction with a suitable extensometer. This work has been temporarily suspended due to the pressure of work of a more urgent character.

A chrome-nickel bar 4 inches in diameter and 8 feet long was prepared to be used for checking the constancy of the large Emery machine in tension. A suitable extensometer was also built in the shops of the Bureau for use in measuring the elongations of this bar under stress. This, while far from the ideal, is the only available method at the present time to keep check on this machine. Its use has been found fairly satisfactory.

A number of testing machines have been calibrated up to 50,000 pounds by the use of the sensitive levers possessed by the Bureau. Comparison has also been made of machines of larger capacity up to 800,000 pounds with the large testing machine in the laboratory of the Bureau. The methods adopted in this case consisted of a tension bar and the comparison of the elongations obtained on the machine in question with the elongations obtained for similar loads upon the Bureau's testing machine. This work, in no sense, can be considered as a calibration and must only be considered as a comparison of machines.

### Investigation of the Effect of Kiln-Drying Spruce.

The scarcity of good air-dried spruce for the purpose of airplane manufacture has led to an investigation of the effect of kiln drying on spruce timber. This investigation is being carried on in cooperation with several furniture manufacturers who have the necessary facilities for kiln drying the lumber. It is hoped that this investigation will result in a suitable method for kiln drying spruce which will give a material as satisfactory for use in airplane construction as the present air-dried spruce. This work has been outlined and is now in

progress. The results, when obtained, will be communicated to the Aircraft Board of the Government for their immediate use.

#### **Airplane Strut Investigation.**

A tentative outline of the investigation of airplane struts was submitted to the various airplane manufacturers for criticism and suggestions before this work was begun. The suggestions made are incorporated into the final program in so far as this was possible.

Work is now under way on an investigation to determine a suitable column formula for use in design of airplane struts. This investigation is being conducted upon air-dried spruce and comprises lengths of  $L/R$  from 25 to 250. It is the intention to determine from this investigation an empirical formula to be used as a guide in the design of airplane struts, no formula at present being available for this work.

#### **Resistance of Wood to Alternating Stress.**

Investigation on the resistance of various kinds of wood to alternating stress was undertaken some time ago. A few preliminary experiments were conducted on a machine now in the possession of the Bureau, but this machine was found to be wholly unsatisfactory for the work. The results obtained, however, were indicative of the necessity of such an investigation and a machine was designed and has been built in the shops of the Bureau. The investigation is now under way. A sufficient number of tests have not yet been made to warrant the drawing of any conclusions. A battery of these machines is now being built so that the results may become immediately available for use at the present time. These results will be communicated to the proper board, when available, for their guidance in the selection of material for aircraft production.

#### **Study of Strains in Car Wheels.**

Work on the strains produced in car wheels under braking conditions has been carried on in cooperation with the metallurgical division. In this investigation, which is of a preliminary nature, the various strains produced in the different parts of the wheel were measured with various temperature conditions of the rim.

As a means of interpreting the measurements made on the wheel under different temperatures, tensile tests were made upon test bars cast from the same melt as the wheel. In this test elongations of the bar were measured for different stresses under a series of temperatures varying from  $20^{\circ}\text{C}$ . to  $300^{\circ}\text{C}$ ., representing the range of temperatures used on the wheel.

#### **Machine-Tool Investigations.**

An important investigation has recently been inaugurated in cooperation with the research committee of the American Society of Mechanical Engineers on the cutting action of machine tools. It is intended to study exhaustively the manner of chip formation as well as the power consumed in the cutting of metals. This is an investigation of exceedingly broad scope and will require considerable time before any definite results can be obtained. There is at present practically no literature on the subject which might be used as a

guide in outlining such an investigation. It is proposed to study different types of tools, different angles of the cutting tools, and different grades of steels for use in these tools. The Bureau some time ago purchased a planer dynamometer for this investigation, but the work has been delayed, as no suitable planer was available. During the past year an 8-foot by 25-foot planer has been installed and work is now in progress.

#### **Strength of Galvanized Wire.**

The Bureau was consulted by a commercial company relative to the reason for loss of ductility in wire due to galvanizing. Samples of this product have been submitted and an investigation is now under way to determine the reason for this brittleness induced by galvanizing and also to determine ways and means to overcome this effect. The results, when obtained, will probably be published as a technologic paper.

#### **Strength of Latticed Aluminum Columns.**

This investigation was undertaken at the request of the Joint Army and Navy Airship Board, in order to determine safe working loads for columns fabricated from light aluminum alloys to be used in dirigible construction. Eighteen columns designed by this board have been tested and a report thereon has been submitted to them.

These columns were of doubtful design and suggestions have been made to the board for their modification. These suggestions were acted upon by the board, and other columns are now being fabricated which will be tested by the Bureau some time in the near future.

#### **Failure of Bridge Material.**

During the year investigations of the failure of bridge material have been undertaken. A bridge which had been in service for about 20 years recently collapsed without warning, resulting in the injury to life and property. This failure is being investigated in order to ascertain if it is due to the peculiar characteristics of the material itself. This work is now in progress and the results will be published as soon as completed.

#### **Strength of Bridge Material.**

The report on the investigation of the strength of large bridge columns was presented for publication and is now in press. The tests were conducted upon 18 columns corresponding to original members in the long-span bridges recently erected at Memphis, Tenn., Metropolis, Ill., and St. Louis, Mo. The columns ranged in length from  $15\frac{1}{2}$  to  $24\frac{1}{2}$  feet, and in cross-sectional area from 42 to 110 square inches, and were constructed of carbon, silicon, chrome, mayari, and nickel steels. The compression strengths of the columns were found from the tests to vary from 31,000 to 45,000 pounds per square inch for the carbon steels and from 47,000 to 61,700 pounds per square inch for the alloy steels. Most of the columns developed a strength equal to the yield points of their component steels; 6, however, failed by local buckling or by bending at the ends. Numerous supplementary tests were made on lattice bars, pin plates, transverse diaphragms, and other details and the laws of behavior determined.

An investigation was conducted in cooperation with a large bridge manufacturing company to furnish reliable data upon the behavior of columns of built-up trusses used in ordinary building construction. The angle columns were tested in lengths from 3 to 25 feet. The experimental work covering 167 columns is completed and the data are being collated for publication.

#### **Failure of Hull Material.**

An investigation of hull material, with a view to determining the cause of failure of a high tensile plate while being handled at the shipping yard, was requested by the Bureau of Construction and Repair. This investigation has been attacked from the standpoint of internal stresses, a large number of measurements having been made upon the plates submitted and some very interesting results obtained. Investigations on the tensile strength and microscopic analysis of this plate have also been made and the results are now being studied. A report embodying certain recommendations on this material will soon be submitted to that bureau.

#### **Investigation of Material from Experimental Bulkheads.**

An investigation was also conducted at the request of the Bureau of Construction and Repair upon material from experimental bulkheads. This investigation comprised physical tests including the determination of the ultimate resilience of the materials in question, as well as microscopic and chemical analysis of the material. This investigation has been completed and a report has been submitted to that bureau.

#### **Investigation of Wire Rope.**

The report on the investigation of the strength and other physical properties of wire rope has been submitted for publication. This report contains a review of individual tests made upon 275 wire ropes ranging in diameters from  $\frac{1}{4}$  inch to  $3\frac{1}{4}$  inches, inclusive; also numerous supplementary tests of wires, fibers in the hemp cores, lubricants, and preservatives used in the manufacture of the rope. The investigation covered five of the more important and commonly used classes of American wire rope.

A cooperative investigation was made with a prominent bridge construction corporation to determine the effects of sheaves upon the tensile strength of steel hoisting rope. The specimens were tested under conditions approximating those existing in the case of hoisting blocks of derricks and dredges for comparison with direct tensile tests. The results of the tests showed that the sheaves reduced the strength in some cases as much as 25 per cent, this depending upon the diameter of the sheaves, which ranged from 10 to 18 inches. The report of these tests has been submitted for publication, and it is believed will be of value to engineering, construction, and erecting firms.

#### **Strength of Brick Piers.**

An investigation of the load-bearing value and other properties of large brick piers has been completed and is being prepared for publication. This investigation was conducted in cooperation with the National Brick Manufacturers Association, and includes tests of 50



brick piers of large size. In the construction of these piers, three grades of brick from each of four widely separated districts east of the Mississippi River were used.

A study was made of various types of bonding and of different grades of mortar. Numerous auxiliary tests were made on the materials used. The methods used in the erection of the test piers is believed to be representative of modern practice in brick masonry, and the districts represented are such as to give a fair average of clay-brick product east of the Mississippi River. The following conclusions are drawn from the results obtained:

The strength of brick piers depends primarily on the quality of brick and kind of mortar used. Of the mortars used, the cement mortar develops about twice the strength of the lime mortars, of 2,700 and 1,400 pounds per square inch, respectively, for the highest grade of brick. The cement mortar is harder to work, however, and a combination lime and cement mortar which does not appreciably effect the strength of the piers is cheaper, and has much better working qualities. The combination used in the present investigation was 1 part of cement and lime (by volume 65 per cent and 35 per cent, respectively), to 3 parts sand. The strength of piers laid in the combination cement and lime mortar was practically the same as those laid in a 1:3 cement mortar, giving twice the strength of those laid in 1:6 lime mortar and about four times the strength of those laid in 1:3 lime mortar. The type of bond as concerns the number of header courses used has little, if any, effect upon the ultimate compressive strength of the piers. The introduction of wire mesh in the horizontal joints adds strength if used in all the joints. This does not apply, however, if used in every third or fourth course only, and may even decrease the strength of the pier. The transverse rather than compressive strength of the individual brick is believed to bear the closer relation to the ultimate strength of brick masonry.

#### **Investigation of the Physical Properties of Earths.**

The investigation of the physical properties of earths was undertaken in cooperation with the committee appointed by the American Society of Civil Engineers to study the subject of a classification for earths suitable for the needs of engineering practice. Numerous experiments have been made to study the behavior of various earths under different conditions of loading, and to determine the most practicable and efficient form of pressure gauges to use in such investigations. The relative frictional resistances, degrees of compression, and cohesive factors in the case of sand and clay when different per cents of moisture are present have been determined. The lateral pressures in earths induced by known vertical loads have been measured and the frictional resistances calculated.

It was shown in the results that a change of density in the earth of but a few per cent is often accompanied by large changes in its physical properties, especially the relative compressibility. The friction and cohesion was generally increased with the addition of different percentages of water in the case of sand. The mean angle of repose for dry standard sand was found to be 39 degrees, a somewhat higher value than that commonly given in engineering treatises. The progress report of this investigation will be given in the August, 1917, proceedings of the American Society of Civil Engineers.

### Information Furnished Regarding Strength of Metals and Alloys.

Services of a consulting nature have been rendered on the strength of steel, alloys, woods, and similar materials. These inquiries, covering a wide range of subjects, have come from private individuals, public officials, State and National Government departments, universities and schools, engineering societies, and research laboratories.

The assistance rendered in this connection is entirely distinct from that of making tests for the determination of the physical properties of materials. Many of the inquiries were in the field of design, others asked for advice on suitable testing machinery and methods of tests. In many cases references to technical literature were sought on various subjects. Advice on the interpretation of existing specifications has often been given and in other cases has been requested regarding the modification of existing specifications. Publications of the Bureau have been furnished whenever the information contained therein would furnish an adequate response to the inquiry. In other cases the available engineering literature was searched and references to suitable articles furnished.

### Tests of a Semi-Investigative Nature.

A great many tests have been conducted of a semi-investigative nature to determine the physical properties on materials as well as to determine suitable material for certain purposes. Among these may be mentioned the following:

1. An investigation of the efficiency of welded steel plate, welded by means of oxy-acetylene and electric processes. These were tested in comparison with riveted joints to determine the relative merits of the different methods of construction.

2. An investigation was made of the burglar-proof qualities of a chest for the Post Office Department. This safe was not found to possess these qualities and the Post Office Department was therefore advised accordingly.

3. An interesting investigation was conducted for the Panama Canal, in which advice was requested on the purchase of shovels for use on the Panama Canal. A thorough strength test and chemical analysis was made of these shovels. A comparison of the results obtained on the bid sample and lot shipment was made and recommendations forwarded to the purchasing department of that organization. These recommendations proved so satisfactory that a second lot was submitted to the Bureau for investigation before purchase was made.

4. Another investigation conducted for the Panama Canal was a thorough study of machetes and grubbing hoes. This investigation included physical, chemical, and microscopic examination of the machetes, with recommendations regarding the material submitted.

Grubbing hoes were submitted to the Bureau for advice as to the selection of two different qualities of grubbing hoe. After investigation the Bureau advised the purchase of the cheaper grade of hoe; in fact, the only difference ascertainable was that of price. This will mean a considerable saving to the purchasing department of that organization.

5. The question of selection of material for periscope tubing was submitted to the Bureau for decision by a large commercial company.

Extensive tests were made of two different grades of material submitted and recommendations as to their respective qualities were made.

6. Hydrostatic tests on a 12-inch oxy-acetylene welded pipe were conducted, at the request of the Supervising Architect. Suitable recommendations were made.

7. An interesting test conducted for the Navy Department was that of the comparative strength of a copper-plated airplane strut compared with a similar strut not plated. This resulted in an increase in weight of about 64 per cent, due to the copper plating and an increase in strength of about 11 per cent.

8. A number of tests have been made during the past year for the metallurgical division in an investigation on welded bronzes. Different methods of welding were investigated and the efficiency of these determined.

9. An investigation was conducted for the Chief of Ordnance of the War Department on the effect of the substitution of soft material for cold-drawn material used in the manufacture of heads for shrapnel shell. This investigation was conducted to learn what effect this substitution would have on the expansion of the Bourrelet, and also to determine if any danger would arise by jamming of the shell in the gun when fired.

10. Advice was also requested relative to the expansion of materials entering into shrapnel, as well as the method to be employed in determining the yield point of the material. An investigation was made of suitable instruments which might be employed in this determination and specific recommendations were made, both upon the method to be employed and the instruments suitable for this work.

#### **Investigation and Testing of Materials for the Signal Corps.**

During the past year the investigations and tests relative to materials used in aircraft construction have reached such magnitude that the office of the Signal Corps has detailed men, assigned to the Bureau and working under its direction, to assist in the execution of this work.

#### **Tests on the Strength of Materials.**

The following is a summary of the testing done in the structural materials division representing a very substantial increase over the number and range of tests conducted during the previous year: Tests for all Government departments, exclusive of the Signal Corps (Aircraft Engineering Division) of the War Department, 613; Signal Corps, 627; private parties, 122; and other tests, 26; total, 1,388.

The material tested included steel wire ropes of 2½ inches and 3½ inches in diameter, manila rope, steel bars, cold chisels, machine bolts, brass tubing, conduit pipe, turnbuckles, carriage bolts, bolt stock, wire, steel rods, dies, structural steel, wood columns, ash, spruce, safety belts, aluminum alloy piston, propeller wood, fuselage wire, angle steel, galvanized pipe, acetylene welded pipe, nickel steel strut, starter shaft, wrist pin, trolley wire, piano wire, cable, rivets, bronzes, sheet metal, brass spinning rod, copper steam pipe, brass hexagon nuts, bronze bearing metal, steel metal slitting saws, etc.

Tests were also made to determine the strength of flanged unions on pipes of 6, 8, and 10 inch diameters; the strength of couplings on

oil-well casings of the same diameter; two tile walls; 10 individual hollow building tile, and approximately 100 individual brick for compression; 85 wire ropes for tensile strength; 2½ 14-inch porcelain insulators were tested to a proof load of 500,000 pounds; and a 50-ton double-end crane hook was tested for proof load of 50 tons.

### **Investigation and Testing of Cement, Concrete, and Stone.**

The work done in connection with the investigation and testing of cement, concrete, and stone, and similar materials is of three kinds, namely: (1) The determination of the physical properties of cements, concretes, sands, crushed stone and gravels, building stones, plaster, drain tile, and other so-called cement products; (2) the development and investigation of methods and apparatus for testing these materials; and (3) the investigation of the durability of these materials under various conditions, and to a certain extent the development of improved methods of handling and utilizing these materials in actual construction; for example, in the mixing and placing of concrete, in the application of stucco and plaster, and in the manufacture of drain tile.

### **Standard Specifications for Portland Cement.**

Meetings of the joint conference of representatives of the United States Government, the American Society for Testing Materials, and the American Society of Civil Engineers, held during the year, resulted in the adoption of a standard specification for Portland cement. This specification became effective January 1, 1917, for the use of all offices of the United States Government, and is an improvement over the old specification. Certain essential requirements, such as strength, fineness, and setting properties, have been increased; certain unessential requirements, such as tests of neat cement, 100-mesh requirement, air and water soundness pats, etc., have been omitted. Other limitations which did not improve the quality of cement, but were a handicap to certain manufacturers, such as the low sulphuric anhydride and magnesia limitations have been made more liberal. The new specification, although an improvement over the old, can not be considered as entirely satisfactory, as there is no test which furnishes specific information as to the relative value in concrete of the products of different mills. Further improvement should be possible in the near future with the continuation of these investigations and researches.

Circular 33, third edition, containing the revised specification for Portland cement, was issued January 18, 1917.

### **Foreign Specifications for Portland Cement.**

A collation is being made of all foreign specifications for Portland cement. This information is being obtained through the assistance of the various consular agents. A large number of specifications have been received from different countries and they will be translated and combined in a paper in the near future.

### **Effect of Fine Grinding of Portland Cement.**

As the result of considerable discussion concerning the value of fine grinding of cement, an investigation was started in 1915 to de-

termine the effect of fineness of cement on its strength and other physical properties.

The results of the compressive strength tests of concretes, containing several brands of cement reground to various degrees of fineness, so far obtained tend to confirm the previous conclusions that, on the average, for each per cent increase in fineness the compressive strength is increased 2 per cent.

#### **Minor Constituents of Portland Cement.**

There is in process of publication the results of work dealing with the effect of magnesium upon the properties of Portland cement. This is one of the minor constituents which are usually supposed to have little or no effect upon the general properties of cement. However, in this work it was shown that a little less than 5 per cent produces a noticeable change in the softening temperature of the clinker, though otherwise the resulting cement is not deleteriously affected. The early strengths which can be developed above 7 per cent are decidedly decreased. The other minor constituents are now in course of being investigated, especially iron oxide and the alkalis. The former retards the setting to a decided degree, but does not materially affect the later hardening. It appears, also, that the alkalis have the property of making the early setting very erratic, in some cases causing it to turn quick-setting during storage.

#### **Constitution of Portland Cement.**

The investigation which is being carried on in the experimental cement plant of the Bureau dealing with the properties of Portland cement as affected by changes in composition has been progressing very satisfactorily during the year. A considerable amount of time has been spent in studying the results at hand, especially through showing the general deportment of the cements in concrete. It appears from these results that the quantity of the various constituents is a factor of great importance, as well as the condition in which they are present.

Thus, it seems that if the same mix is burned at two different temperatures, that temperature which produces the finer grained clinker will produce the most active cement. Very hard-burned clinker, especially when the constituents are larger grained or crystalline, does not appear as active as clinker burned at a low temperature for a longer period. As a result, thin sections of all clinker in the investigation have been made and are being examined both for the amounts and the character of the various constituents.

#### **Granulometric Air Analyzer.**

The granulometric air analyzer which has been in successful operation for three years, continues to demonstrate its usefulness in the quantitative separation of finely ground cements and other powders. Aside from more or less routine mechanical analysis of cements, the analyzer has been employed in the study of foundry clays and moulding sands, and for the separation of carbon, copper, and emery powders.

#### **Air Separator for Cement.**

An apparatus has been devised for the separation of "flour" from the coarse material of Portland cement by means of air. Flour of

3 degrees of fineness is now obtained. During the past year improvements have been made in this apparatus, consisting mainly of a new feeding device which increases the efficiency of operation, and a new dust collector has also been designed.

While the air separator is still in the experimental stage, it has already produced a large amount of fine material which has been used in the very important investigation of the value of fineness of Portland cement. Up to the present time this is the only known device capable of separating the fine particles of cement from the coarser material in considerable quantity, and at the same time controlling absolutely the degree of fineness of the separated material. The control both of fineness and gradation is an absolute prerequisite for success in studying the effect of fine grinding of cement on the strength of mortars and concretes, and the chief obstacle to rapid progress in the investigation is the excessive slowness in production of the fine grades of cement of normal granulometric composition. Consequently, it is important that the air separator be developed primarily for larger capacity, and steps have already been taken to meet this requirement.

#### **Standard Cement Sieves.**

Thirty-two 200-mesh sieves have been calibrated during the year to determine whether they meet the Bureau's modified sieve specification which was adopted in 1914. This service has been of much assistance to testing laboratories, as a correction factor is furnished with the certificate of test. The application of this correction factor makes possible much greater concordance of results than were previously obtainable, thereby preventing many disputes between the manufacturer and consumer. With the increase in the fineness requirement of specifications for cement this work should be of still greater service to the public. The comparatively small number of sieves tested this year is an indication of the scarcity of high grade sieving cloth, which is entirely an imported product, and also that laboratories and manufacturers are making more and more use of the Bureau's standard fineness samples.

#### **Standard Fineness Sample.**

New cement samples of standard fineness have recently been prepared and made available to owners of cement-testing sieves. These samples are used for checking the sieving values of such sieves, and afford a means of comparing the so-called standard sieves with the fundamental standards maintained at the Bureau. The new samples are slightly finer than those previously issued, conforming more nearly to the requirements of the cement specifications adopted January 1, 1917.

#### **Hydraulic Cements Other than Portland Cement.**

The investigation of the compounds of lime and alumina with small amounts of impurities of silica, iron oxide, and magnesium have been continued with most gratifying results. Alumina and lime burned in the rotary kiln in the proportion of 1 to 1, or 5 to 3 and then ground, give cements which have much greater strength in concrete than Portland cement. One to 6 gravel concrete gave a

strength of almost 3,000 pounds per square inch at the end of 24 hours. This showed continuous gain up to six months, when a strength of 7,600 pounds per square inch had been attained. Specimens stored in the drying closet showed a decrease after this time to 6,700 pounds, while those stored in the laboratory after this period increased to 8,200 pounds per square inch at the end of a year.

This high strength was due to the quick hardening (but slow setting) of the aluminate which is accompanied by the splitting off of colloidal hydrated alumina. This latter acts as a mineral glue. That the strength developed is greater than that developed by Portland cement is due to the greater amount of colloidal material formed.

#### **Durability of Concrete in Sea Water.**

The investigation of the effect of sea water on concrete has been continued and practically all concrete structures on the coasts of North America, Panama, and Cuba have been examined and reports have been issued to the Navy Department on several of the yards. Data are being collated on the condition of concrete and methods employed in construction of concrete structures in various harbors of the world. These data are being obtained through the various consular agents and reports have been received on a large number of structures.

The investigation has shown that all concrete exposed to sea water, irrespective of location, is subject to chemical disintegration unless properly fabricated and protected. If sufficient care is taken and proper designs and methods followed, the concrete will be durable. Practically all reinforced concrete structures, including those owned by the Government and public, in sea water are failing, due to improper design which causes the corrosion of the reinforcement. The conditions found demonstrate that the designs advocated by present engineering practice will not insure permanent or durable structures. It is anticipated that the results of this investigation will be published during the ensuing year.

#### **Durability of Concrete in Alkali Waters.**

The investigation of the durability of concrete in alkali waters was started in 1913, and was instituted because of its importance to various branches of the Government using concrete in irrigated districts, where the alkali occasionally becomes concentrated in the soil, and as a result of the many requests received for information on the subject. The investigation is being conducted in cooperation with the Reclamation Service, the drainage division of the Department of Agriculture, and the Portland Cement Association, to determine the durability of concrete of various kinds in concentrated alkali soils and methods of mitigating failure.

As part of the investigation some 8,000 specially prepared drain tile made under the Bureau's supervision were installed in concentrated alkali soils in Colorado, Montana, Wyoming, Arizona, Washington, New Mexico, and Utah. A number of these tile are taken up and tested each year. The results of the first year's tests were published in Technologic Paper No. 44.

As an extension of this work, a large number of concrete blocks were made using aggregates to be found on the various projects as

well as an aggregate of known excellent quality at Denver. These blocks were installed in localities similar to those in which the drain tile were installed and are to be examined from time to time for indications of disintegration.

A second progress report has been prepared, to be published as Technologic Paper No. 95. This paper contains the results of tests of drain tile made during the first three years and a statement of the condition of the concrete blocks after one year's exposure. The results show that concrete and cement drain tile will disintegrate in some of these soils, unless the best of materials are used and special care is exercised in fabrication.

The results of tests made in 1916 showed that many of the tile installed on one of the projects in the Middle West had been attacked by some agent in the soil or drainage water. There is no alkali present in the soil on this particular project and the type of disintegration differs from that found in the western drains, where the drainage waters carry appreciable quantities of alkali salts. Since thousands of miles of cement tile drains installed in the humid regions of the East and Middle West are apparently giving satisfaction after years of service, it is not believed that this type of disintegration is general, although it confirms complaints as to the lack of durability of cement drain tile in widely separated districts of the East and Middle West, where failures have been found and previously explained as being due to the use of poor aggregates and improper methods of manufacture. An investigation is being made to determine the extent and cause of this type of failure. Additional tests are to be made from year to year and the report amended as results are available.

#### **Investigation of Integral Waterproofing Compounds.**

In compliance with a demand for more definite information concerning the value of integral waterproofing compounds, an advisory committee was organized in 1916, composed of representatives of the Government, engineering societies, waterproofing companies, and prominent engineers interested in this investigation, to formulate a program. The program which resulted from several meetings of this committee contemplated the construction of concrete tanks by contract, both with and without waterproofing compounds, under conditions simulating actual field conditions. All arrangements were completed for carrying out this program, but the increased work incident to the national emergency has caused the temporary postponement of this investigation.

During the year a number of waterproofing compounds were tested in the laboratory. Special tests were made on Toxement waterproofing compound for a Government department to determine the effect of its addition to concrete upon the density and weight. Its addition was found to materially decrease the density and decrease the weight per cubic foot.

#### **Development of an Accelerator for Hardening Concrete.**

At the request of the United States engineer office at Memphis, Tenn., an investigation was made to develop a method of producing a concrete which would have considerable strength in a comparatively short time. The results of tests indicate that the addition of a small



amount of calcium chloride with some cements in 1:2:4 concrete resulted in a strength increase of about 100 per cent in 24 and 48 hours. To further substantiate these results and obtain information as to the durability of concrete containing small amounts of calcium chloride, a comprehensive series of tests have been started. The results obtained to date indicate that concrete gaged with a 6 per cent solution of calcium chloride increases in strength from 60 to 110 per cent in two and three days. The results of tests up to six months do not show any detrimental effect from the addition of the calcium chloride.

#### **Cast-Iron Reinforced Concrete Columns.**

There is now being prepared for publication the results of tests of 20 concrete columns which contained as an unusual feature cast iron as reinforcement. This method of reinforcing was proposed by von Emperger, who used the cast iron in the form of hollow cast-iron pipe which formed the core of the column. The concrete is cast around this hollow core, which may, if desired, be filled with concrete, and reinforced with the usual spiral reinforcing.

The results show that this type of column would be very economical so far as cost is concerned. The cast iron is not stressed to more than 60 per cent of its maximum strength when the concrete fails, and also apparently is strengthened by the concrete, so that all local weaknesses are eliminated and there is no sudden failure so common to plain cast-iron columns. The columns were able to carry stresses amounting to 10,000 pounds per square inch and like hooped columns gave pronounced indication of approaching failure.

#### **Floor Construction Tests.**

An investigation was made of two types of floors recently introduced in Washington. At the request of the District building department, a loading test was made on a "Schuster" two-way reinforced combination hollow tile and concrete floor. For the Navy Department a test was made on a "Metropolitan" gypsum composition floor reinforced with twisted steel cables. This type of floor combines strength and elasticity with lightness of construction, and has been subsequently used by the Navy Department in some of their new structures.

#### **Investigation of Composition Flooring.**

This term is applied to certain noncombustible resilient flooring preparations in which the binder or cementitious material is "Sorel" or magnesium oxychloride cement. The other ingredients of the preparation are certain inorganic fillers, such as very finely ground quartz or limestone, asbestos, wood flour, and coloring agents. The finished floor has certain properties such as resilience, quietness, and lack of changes of volume, which allow it to be used in large slabs.

In order to obtain certain basic information in regard to the effect of foreign bodies in the ingredients and, also, information in regard to the effect of varying the amounts of the ingredients usually used, extended investigations have been started. This Bureau is making use of the active cooperation of a newly formed National Composition Flooring Association which is desirous of having a uniform specification drawn up covering their product.

This problem is of particular interest at the present time in view of a necessary change in the source of the magnesite. This latter material had, until the last two years, been obtained from Greece. When this supply was cut off active prospecting was undertaken in this country and some fairly good deposits located in California. The problem was further complicated by the fact that the imported material was delivered in this country in the calcined form. Since the proper calcination of the magnesite is of fundamental importance, this has been made one of the phases of the investigation.

#### **Value of Various Materials as Concrete Aggregate.**

In cooperation with State geologists and others, representative samples of mine tailings, crushed slag, sands, gravels, and stones are being obtained for test to determine their suitability as aggregates for concrete mixtures. A large number of tests have been made on fine and coarse aggregates from various sections of the United States. Comprehensive tests of the value of basalt and other aggregates from the Columbia River district, Washington, were made. The results of the investigations will be published upon their completion.

#### **Effect of Moisture and Temperature Changes on Concrete.**

Work was continued on the investigation of the action of concrete when subjected to a variation of temperature and moisture conditions. The present work has been confined to making measurements on concrete roads and pavements with the ultimate aim of determining the most effective distance for the spacing of transverse joints in concrete. During the past year numerous measurements have been made on experimental slabs installed on the Bureau grounds and on a Delaware road. These measurements confirm previous results in indicating that the concrete is subject to a rather definite annual cycle of changes in volume; during the wet and warm spring months an expansion occurs in the concrete, and during the drier months the concrete contracts.

A portable comparator is being used to measure accurately the volumetric changes in various cement mortars and plasters. The initial work has consisted of determining the contraction which occurs when a cement mortar obtains its set. Work has been done with mortars of various degrees of richness and results show that lean mixtures contract less than rich, and that mortars mixed when the humidity is high contract less than when mixed at the time the humidity is low. This work is being continued, and it is anticipated that a report will be issued during the ensuing year.

#### **Tests of Field-Made Concrete for Lincoln Memorial.**

Concrete cubes and cylinders of varying consistencies were made in the field from the concrete as actually used in the construction of the approaches to the Lincoln Memorial. These specimens were tested at various ages to determine their compressive strength. The results showed that the concrete of a consistency suitable for chuting was of sufficient strength to meet the requirements of the work.

#### **Investigation of Building Stones of the United States.**

In connection with the cooperative investigation of building stones which is being carried on with the United States Geological Survey,

Bureau of Mines, and Office of Public Roads, 50 samples of commercial marble have been tested to determine their compressive strength in a dry and wet state, transverse strength, perpendicular and parallel to the bedding, tensile strength perpendicular and parallel to the bedding, percentage of water absorption, specific gravity, porosity, weight per cubic foot, electrical conductivity, coefficient of expansion, resistance to frost action, resistance to the penetration of stains, and chemical composition. A report on these tests is now being prepared for publication.

A collection of the various commercial marbles has been made and placed on file at the Bureau of Standards. This collection at present consists of 75 polished slabs 8 inches by 12 inches and represents the principal commercial marbles of Vermont, Massachusetts, New York, Maryland, Georgia, North Carolina, Alabama, Missouri, Colorado, and California. This collection is now exhibited in suitable cases and may be examined by those interested in studying and comparing the various types of American marble.

Thirty-five samples of sandstone have been collected from the important quarries of the United States and the work of preparing test specimens is well underway. The physical properties of these will be determined in approximately the same manner as those of the marble.

Various samples of building stones submitted by other Government departments have been tested to determine their suitability for particular purposes.

#### Stucco and Plaster Investigation.

A series of tests, primarily to determine the comparative durability of various types of plastered metal lath on exterior walls, was undertaken in 1911. The results of these tests, obtained from the exposure of small panels, indicated the necessity of carrying out an investigation on a much larger scale. Accordingly a new and more comprehensive series of tests were planned, the program of which was put into the hands of an advisory committee consisting of representatives from the Government, engineering societies, the Associated Metal Lath Manufacturers, the Portland Cement Association, the Gypsum Industries Association, the National Lime Manufacturers' Association, the Hollow Tile Manufacturers' Association, and a number of engineers, contracting plasterers, and specialists. The recommendations of this committee were followed in the construction of a test structure, approximately 200 feet long, 26 feet wide, and 24 feet high, the exterior walls of which are divided into 56 panels approximately 15 feet wide and 10 feet high. These panels are constructed of terra cotta hollow tile, monolithic concrete, brick, gypsum block, plaster board, and wood and metal lath, and are plastered with a number of typical stuccos, the work being carried out under the supervision of the advisory committee. The structure was completed in November, 1915.

The first progress report on this investigation has been published as Technologic Paper No. 70. This report is mainly descriptive, giving the complete history of the test structure and the individual panels, together with a statement of the condition of the panels in April, 1916.

In the summer and fall of 1916 an addition to the test structure was erected, providing 22 new panels, the specifications for which were based largely on suggestions obtained from a study of the original panels, and approved by the stucco committee. A report on the new panels will be embodied in the second progress report to be issued during the coming year, in which it is planned to include a full discussion of the results obtained to date, and a tentative stucco specification setting forth the fundamental requirements of base construction, mixtures, and application. While this tentative specification will undoubtedly be modified in the light of later developments in the investigation, it will nevertheless make available the information gathered by the committee from a more comprehensive study of the subject than has ever before been attempted.

The field examination of stuccos originally planned as a part of the investigation has been begun by a study of stucco structures from 1 to 20 years old, mainly residences, in the vicinity of Philadelphia, New York, Boston, Cleveland, Chicago, and Pittsburgh. It is not planned to publish the results of the field inspection until the country has been more widely covered, but frequent reference to the field observations, so far as available, will undoubtedly be made in the second progress report.

The experimental work on interior plasters, which was to have been begun in 1917, has been postponed, probably for the duration of the war. Greatly as this work was desired by the committee, there was no hesitation on the part of any who had contributed to the funds for erecting the test structure in authorizing its use for laboratory purposes. The temporary and permanent alterations in this building will not interfere with the future carrying out of the original plans.

#### Information Furnished Concerning Cement and Concrete.

Many inquiries were received during the year from architects, engineers, contractors, and builders who sought information concerning methods of waterproofing concrete, the value of waterproofing compounds, methods of construction to be employed in sea water, effect of using sea water for mixing concrete to be placed in sea water, physical properties of concretes of various mixtures, the cause of staining of plaster walls and ceilings, the relative value of various concrete aggregates, methods of making magnesite composition floors, methods of preventing dusting of cement floors, methods of designing concrete road slabs, suggestions for building code requirements, the cause of failure of concrete structures, durability of cement drain tile, the effect of sewage on concrete, the physical properties of marbles, methods of treating stone to reduce absorption, specification for stucco, fire-resisting properties of structural materials, the corrosion of metal lath, reinforcement of gypsum plasters, the interpretation of cement specifications, methods of coloring concrete, etc.

From the general public requests were received for information on methods of mixing concrete, laying of concrete sidewalks, waterproofing basements, suitability of various materials for use in concrete, durability of concrete in sea water, durability of composition magnesite floors, the physical properties of stone, the cause of failure

of drain tile, the effect of frost action on concrete, suitability of concrete for oil and acid storage tanks, quality of American Portland cements, dampproofing brick and tile walls, dusting of concrete floors, corrosion of metal lath, etc.

From cement manufacturers, architectural stone manufacturers, and commercial testing laboratories requests were received for information on the accuracy of sieves, methods of standardizing sieves, the physical properties of concrete, the value of fine grinding, apparatus for granulometric analysis, cause of failure of drain tile, the interpretation of cement specifications, quick hardening concrete, standard methods of testing, etc.

#### **Publications on Cement and Concrete.**

The following papers on the subject of cement and concrete were published during the year: Technologic Paper No. 58, *Strength and Other Properties of Concretes as Affected by Materials and Methods of Preparation*; Technologic Paper No. 70, *Durability of Stucco and Plaster Construction*; and Circular No. 33, third edition (revised), *United States Government Specifications for Portland Cement*. One paper is in course of preparation and will be published as Technologic Paper No. 95, *Durability of Cement Drain Tile and Concrete in Alkali Soils*.

#### **Routine Cement Inspection and Testing of Cement and Concrete.**

Cement was inspected during the year at 16 different cement mills, located in Virginia, Maryland, Pennsylvania, and New Jersey. The inspection work included the taking of samples, their testing, and subsequent supervision of packing and shipment to the various departments and offices of the Government. A total of 8,345 samples were tested for the Navy, War, Treasury, Post Office, Commerce, and Interior Departments, Panama Canal, Supervising Architect's Office, District of Columbia, Lincoln Memorial Commission, Smithsonian Institution, State of Massachusetts, etc. Inspection was made of 295,720 barrels of cement for shipment to Panama and 351,650 barrels for shipment to Government departments in the United States, for use in the construction of Federal buildings, river and harbor improvements, and for the State of Massachusetts. Cement was inspected for export for one company and certificates of the quality were furnished previous to shipment to Argentina. The inspection of all cement used by the District of Columbia necessitated that an inspector be stationed permanently at the cement mill in Maryland. Shipments to the District have ranged during construction periods from 1 to 4 carloads daily. During the year 72,000 barrels of cement were rejected on account of failure to meet the Government specifications.

A considerable amount of cement was made and tested at the Pittsburgh branch of the Bureau in cooperation with various societies in the course of formulating new specifications for Portland cement. A very large number of concrete cylinders were also tested, as part of a study the Bureau is making of cement manufactured in its own experimental cement plant.

Seven concrete columns 20 inches in cross section and varying in length from 5 to 10 feet, taken from a collapsed structure, were

tested to determine whether the concrete was of a satisfactory quality. These columns proved of particular interest, as they showed to a very marked extent the effect of excessively wet mixes. The fine material from the concrete had segregated in layers in the column to a depth of several inches, producing planes of practically no strength, although through the main part of the column the concrete was of fair quality.

### Miscellaneous Tests of Stone, Sand, Gravel, etc.

During the year a total of 355 miscellaneous samples, consisting of sands, screenings, gravels, stones, asbestos roofing boards, waterproofing compounds, gypsum, magnesite cements, concrete, alkaline soils, waters, etc., were received for test.

### Sand-Lime Brick.

It is believed that sand-lime brick of better quality and less cost can be made by improving the methods of manufacture. An investigation was first undertaken to determine the effect of various factors upon the properties of a brick-made lime and sand, both of very fine size of grain, that is, smaller than 200 mesh. A decidedly stronger brick was obtained with a composition of equal parts by weight of lime hydrate and sand than with any other proportion. The best molding pressure was found to be 10,000 pounds per square inch. Maximum strength was attained by steaming from 4 to 8 hours, longer periods causing a decrease in strength. This result in steaming was found to occur also with brick containing 10 per cent lime hydrate and 90 per cent of sand graded from 20 mesh to dust.

The investigation is being continued, using graded sand to replace the 200 mesh sand. The factor now being studied is the effect of the size of grain of the sand upon the compressive strength, transverse strength, and absorption of the brick.

### Hydrated Lime in Concrete.

Hydrated lime in small amounts is being added to a great deal of the concrete now being used for various reasons. It is desirable to know the effect of such an addition upon the properties of the concrete, and with this in view an extended series of tests was inaugurated covering the compressive strength, absorption, adhesion to reinforcing, coefficient of expansion, etc., of concrete. A preliminary résumé of the results show as follows:

Compressive strength is in general decreased from 1 to 20 per cent by additions of hydrated lime, but in some instances the strength is increased. Strength tests were made upon 1:1½:3, 1:2:4, 1:2½:5, and 1:3:6 concretes of various ages up to one year. Two-year and five-year specimens remain to be tested.

Additions of lime hydrate increased the absorption of water by concrete from 10 to 50 per cent. The order of increase is indicated by a change of from 6 to 8 per cent absorption in a 1:3:6 concrete.

The adhesion of concrete to steel was decreased from 1 to 40 per cent by additions of from 10 to 20 per cent of lime hydrate.

The effect of lime hydrate upon the expansion of concrete is being determined, using bars 4 inches by 4 inches by 4 feet. It is proposed

to continue the investigation, determining the effect of lime upon segregation of aggregate and resistance to abrasion.

### **Measuring of Plasticity and Sand-Carrying Capacity of Lime.**

The plasticity and sand-carrying capacity of lime are of great importance commercially, but no satisfactory method of measuring these properties has been so far devised. After a considerable number of experiments, an entirely new machine has been constructed for this purpose. A lime paste or mortar is molded into a cylindrical form and pressure applied by means of a paddle pressed against the revolving specimen. The tangential and vertical forces acting upon the specimen are measured and from these the coefficient of friction is determined. The test is repeated, placing the specimen upon a plaster block which absorbs water from the paste, causing a more or less rapid increase in the magnitude of the force acting upon it. From these data the work done upon the specimen is calculated.

A comparatively low coefficient of friction and a low value for work done indicate a plastic lime. The machine is being tested out thoroughly by the use of a number of lime hydrates from various parts of the country.

### **Properties of Hydrated Limes.**

It was found that very few hydrated limes passed the standard specifications adopted in 1915 by the American Society for Testing Materials. Consequently 34 samples of hydrate were collected from various sections of the country and thoroughly tested according to the existing and to certain proposed specifications. The latter were adopted as tentative specifications for masons' hydrate by the American Society for Testing Materials in June, 1917. In order to aid in drawing up final standard specifications, the examination of lime hydrates is being continued. In conducting cooperative investigations of this kind, the Bureau is able not only to make reliable suggestions but also to obtain a very desirable knowledge of the material under consideration as it appears on the market.

### **Decomposition of Calcium and Magnesium Hydroxides.**

The decomposition of calcium and magnesium enters into a number of problems connected with the manufacture, testing, and use of hydrated lime, since the latter is composed chiefly of calcium hydroxide and sometimes contains more or less magnesium hydroxide. The temperature of decomposition of these hydroxides and the rates of decomposition at various temperatures have been determined. From the results a method is being developed for determining the degree of hydration of these two oxides in lime hydrates. This is very necessary, as it has been found that lime hydrate which has been "burned" or had part of the combined water driven off by too high a temperature during hydration loses some of its plastic properties.

### **Investigation of Gypsum.**

This Bureau is cooperating with a number of manufacturers and societies in devising methods of testing and specifications for gypsum and gypsum products. The tests investigated and the methods for conducting them adopted by the committee were: (1) Determina-

tion of free water for raw gypsum only; (2) fineness; (3) chemical analysis of raw or of calcined gypsum; (4) precaution for physical tests; (5) normal consistency; (6) water-carrying capacity; (7) dry bulk; (8) tensile strength; and (9) microscopic investigation.

### **Architectural Terra Cotta.**

The use of certain burned clays in the molded or cast form, known as architectural terra cotta to distinguish it from terra cotta or hollow building tile, is increasing very rapidly, supplanting to a certain degree cut stone and architectural metals. As a larger part of the output is placed on the exterior of buildings, where it is subjected to all the severe weather conditions of this climate, it is very essential that it must have certain weather-resisting properties. It is also in certain unforeseen cases called upon to take stresses induced by movements of parts or the whole of the structure.

Under these conditions it seemed desirable to determine the physical characteristics of terra cotta as now manufactured in order to ascertain if it is possible to improve the present method of manufacture and also to study its use and methods of placement in structures. This investigation will begin with a study of the various clays used and will follow the material through its various stages until its final placement on the structure.

### **Investigation of Tile and Tile Walls.**

A report of the results of tests on about 200 hollow building tile is being prepared for publication. These tile developed strengths ranging from 4,000 to over 10,000 pounds per square inch when tested on end and about one-half to three-fourths of these amounts when tested on edge or flat. The tests made to determine the relative degree of absorption of water showed values ranging from 6 to 11 per cent; a vitrified tile to the same scale of hardness ranging between 1 and 2 per cent. The strength of the tile was found to decrease almost directly with its degree of absorption.

The tile program also includes the testing of walls of widths from 3 to 6 feet; of from 6 to 8, and 12 inches in thickness; and of uniform heights of 12 feet. The strength of a wall tested in this manner varies approximately from 200,000 to 600,000 pounds, depending on the thickness of the wall. About 10 walls have been tested and the work will be continued for the present year. The program is being carried out in concert with other laboratories, each laboratory endeavoring to cover the different geographical clay and manufacturing districts.

### **Silica-Brick Investigation.**

The extensive study of silica refractories, begun in 1916, has been practically completed. Several important facts have been brought out in connection with this work. Thus it has been found that well-burned silica bricks should show a specific gravity of not more than 2.36, and upon refring to 1,500° C. a linear expansion of not more than 2 per cent in terms of the original length. Simple tests of this kind offer a ready means of detecting inferior products, a fact of considerable importance to the by-produce coke oven and the steel industries, which largely depend upon the use of silica refractories.



### Study of American Clay Refractories.

For the purpose of assisting in the classification of American clay refractories, a large number of fire bricks have been examined with reference to their softening temperature, their ability to resist a pressure of 40 pounds per square inch at 1,350° C., and their volume and porosity at various temperatures up to 1,500° C. Since most of the domestic makes are represented in this series of tests, the information should be of a fundamental character and useful in the preparation of specifications governing their use.

### Special Refractories for High Furnace Temperatures.

In meeting very severe furnace conditions which prevail when crude oil is used as a fuel, as under marine boilers, the employment of refractories possessing a wide margin of safety would be very desirable, since these would make it possible to force combustion when occasion requires it. A study of special refractories for this purpose was made and resulted in the production of bodies consisting of calcined high-grade flint clay with kaolin as the bonding material, which are capable of standing up under extremely severe conditions, both as to temperature and pressure. Still more refractory bodies were produced from a mixture of kaolin and alumina, partly precalcined, which approach the composition of sillimanite,  $\text{Al}_2\text{O}_3\cdot\text{SiO}_2$ . For very high temperatures a composition was developed consisting of 84 parts (by weight) of magnesite and 102 parts of calcined alumina, intimately blended and fired to a high temperature. Crucibles were made from this mixture, which corresponds to that of magnesia spinel. These were able to resist a temperature of 1,700° C. very satisfactorily. Materials of this type formerly were produced only by the Royal Porcelain Manufactory at Berlin.

### Study of Ceramic Kilns.

With the constant increase in the cost of coal the fuel consumption of ceramic kilns and furnaces has become a question of national importance. It is evident that kilns of the greatest thermal efficiency must be employed and the firing processes must therefore be conducted economically. This subject received attention during the past year in the study of a new type of kiln, the so-called tunnel kiln, an installation of which, in New Jersey, was closely examined with reference to its heat efficiency, temperature distribution, and character of heat losses.

A kiln of the older, down-draft type, but fired with producer gas, was made the subject of another study. This kiln, located in Indiana, was tested in a similar manner, and incidentally information was collected concerning the advisability of using producer gas as a fuel for periodic kilns. These reports have been completed and will appear in the form of a technical paper.

### American Plastic Bond Clays.

A study of 28 domestic plastic fire clays suitable for use in the manufacture of glass pots and graphite crucibles has been completed. It has been shown that from the standpoint of quality the domestic materials are available, which make possible the replacement of the clays formerly imported from Europe. Attention, however, has been

called to the necessity and desirability of blending two or more clays, thus replacing the old practice of depending upon a single clay.

Emphasis has been placed upon controlling the properties of the mixtures which are impossible when only one clay is used. In spite of the difficulties now being experienced by manufacturers of such refractories, the principles enunciated should prove of value in building up a sound practice. In the paper on this subject now in preparation both the European and the American methods of manufacturing glass refractories and crucibles are reviewed and described.

### **Sizing of Calcined Clay.**

The sizing of the grains of calcined clay in mixtures used for the making of glass pots, crucibles, sanitary ware, etc., has a very important effect upon the resulting structure of the fired product. The results obtained by varying the amount of each size of grain for different purposes have been worked out in an elaborate investigation, which has been completed and is being submitted for publication.

### **Clay Tests.**

Approximately 300 tests of clays have been made for State geological surveys and private individuals, especially with reference to finding new sources of kaolins, plastic bonding, and paper clays. Several new deposits of suitable clay have thus been located in Alabama. A number of clays have also been tested with reference to their adaptation to new uses, especially in connection with the manufacture of chemical stoneware. In several instances detrimental properties of clays now being used have been detected and attention called to their defects.

### **Porcelain Investigation.**

In the continuation of the study of porcelains the scope of the work has been greatly extended and now includes practically the entire field of hard-fire porcelains based entirely on the use of domestic clays and kaolins. New features have also been introduced by replacing the quartz (flint) by calcined kaolin, artificial sillimanite, fused alumina, and zirconium oxide. Similarly, the feldspar has been replaced, either wholly or in part, by eutectic combinations of kaolin, quartz, and magnesia. In this manner it has been found possible to produce entirely new types of porcelains with characteristic properties. Such properties as the softening temperature, the vitrification range, and the volume changes which the porcelains undergo are being determined for each of the 90 porcelain compositions.

### **Porcelain for Spark Plugs.**

The insistent demand for spark plugs capable of standing up under severe use in aeroplanes, tractors, etc., has been the incentive for conducting experiments aiming to produce bodies capable of giving maximum service. For this purpose the compositions of the French and German special spark plugs have been reproduced and are now being tested for dielectric strength in the laboratories of the Bureau. Additional hard-fire porcelain compositions are likewise being tried out for this purpose.

### **Enameled-Iron Investigations.**

Two technical papers are in course of preparation on this general subject, one dealing with the manufacture of enameled cast iron and the other of sheet-steel products. Although these industries are rapidly increasing in magnitude and importance, the technical literature relating to the processes involved has been very meager and sometimes misleading. In the work now in preparation the attempt will be made to correlate the information available and to bring out principles not generally recognized. A comparison is also being made of American and foreign enameled products.

### **Optical Glass Investigation.**

The work on optical glass progressed as far as it could with the laboratory equipment available. For this reason, during the latter half of the fiscal year a larger furnace was installed capable of holding one pot carrying a charge as large as 1,000 pounds. With this unit, it has been found possible to make successful melts of crown and prism glass. Experiments are being conducted upon other glasses which are in demand.

In order to increase the rate of progress in this work, a new kiln house with eight melting furnaces and suitable molding and testing equipment is being erected.

Pots for use in connection with optical glass are now being made from domestic raw materials for the purpose of developing suitable compositions for special glasses which are very severe upon the clay mass of the pot.

### **Investigation of Lubricating Oils.**

The test for demulsibility or resistance of an oil to emulsification was reported upon last year. A description of this test, published by the Bureau as Technologic Paper No. 86, aroused so much interest among refiners and consumers that the Bureau's supply of copies for free distribution was exhausted within a month. The Panama Canal has incorporated this test in specifications for steam turbine oil.

The determination of viscosity so that it may be expressed in some rational unit is a matter of much importance, as the vague units in common use frequently lead to confusion. Considerable work has been done toward the standardization of the Saybolt Universal Viscosimeter, but the completion of this investigation has been delayed by the great amount of war work on hand. A preliminary account of this work has been published in a paper presented before the American Society for Testing Materials at Atlantic City and a technologic paper has been prepared which gives a more complete account of the method of determining absolute viscosity.

### **Information Furnished Regarding Lubricating Oils.**

Ordinarily, tests are not made for private parties, but many requests are received from large consumers for advice concerning the testing of oil. A very large amount of correspondence has been conducted during the past year in compliance with such requests. Addresses have also been delivered before associations by representatives of the Bureau concerning the testing of lubricating oils.

### **Investigation of Leather.**

There are differences of opinion among tanners, manufacturers, and consumers regarding the relative value and wearing quality of different tannages of leather used in the manufacture of shoes and no satisfactory specification or method of test has been developed. The problem is of special importance at the present time in view of the large quantity of leather required for military purposes. This situation has caused the Bureau to take up an investigation of the subject and the hearty cooperation of the National Association of Tanners has been secured.

During the past year experiments have been conducted, with very encouraging results, with a machine designed for testing the wearing quality of sole leather. Interesting experimental results have been recently obtained in testing the wearing quality at different parts of the hide. The results obtained, when considered in connection with an examination of the leather tested, were pronounced by a number of leading sole-leather tanners to be in accord with the known variation in wearing quality as learned by years of experience. This fact may be offered as strong evidence in favor of the value secured by the testing machine. If the machine gives true indications of the relative wearing quality at different points of a hide, it may be assumed that its results will indicate correctly the wearing quality of different leathers.

Experiments will be continued to include the different tannages of commercial leather with the view of determining their relative wearing quality. The wearing quality will be studied by comparing the results obtained with the Bureau's testing machine with the results of actual service tests. Other physical properties will be studied and chemical analyses will be made in order to develop standard specifications and methods of testing. Tests will also be made to determine the relative wearing quality of sole leather as compared with the numerous leather substitutes.

### **Investigation of Shark and Other Fish-Skin Leather.**

The Bureau, in collaboration with the Bureau of Fisheries, is investigating the problem of tanning shark and other fish skins. A large number of skins have been distributed among the various tanners who are experimenting with the methods of producing tanned skins of a quality that may be used as a substitute for certain grades of leather. The experiments have not been entirely successful in all cases, but a number of tanned skins submitted for test have given very encouraging results. The Bureau is investigating the physical properties of the different tannages and it is thought that further experiments will develop methods of tanning by which fish skins may be made into leather adapted for many useful purposes.

### **Experimental Rubber Plant.**

Some progress has been made in studying the physical properties of rubber, but a very limited amount of time could only be devoted to this subject on account of the great amount of routine work. Additional data have been secured on the effect of dry heat on rubber stationery bands, rubber insulation of wire, and rubber compounds in general.

The machine designed at the Bureau for testing the wearing quality of sole leather has been used experimentally for studying the relative wearing quality of rubber compounds such as are used for the tread of pneumatic tires. Eighteen compounds have been experimented with and the results indicate that the apparatus may be adapted for testing the wearing quality of tire stock and rubber-composition soles.

The Bureau's experimental rubber-mixing plant has been handicapped to a great extent during the past year by the unusual demands for special tests along other lines.

Eight rubber compounds were mixed and vulcanized into sheets in connection with a study of the aging properties of rubber.

About 50 pounds of crude rubber were washed and dried and 19 rubber compounds were mixed and vulcanized for experimental purposes.

#### **Investigation of Solid-Rubber Tires for Motor Trucks.**

The Bureau is investigating the physical and chemical properties of solid-rubber automobile tires for the War Department. Tires of different manufacturers have been secured and experimental work is already under way to ascertain the physical and chemical characteristics of the different rubber compounds used, with the object of establishing definite specifications and methods of testing.

#### **Rubber Eye Shades for the Range Finders of Battleships.**

During the fiscal year 1915 the Bureau conducted experiments for the Navy Department with the view of producing a rubber compound that would be suited for eye shades to be used in connection with the range finders of battleships. Numerous trial compounds were mixed and vulcanized into eye shades which, after being subjected to service conditions for about six months, were returned to the Bureau for examination. Several of the samples were found to have given good service and of these a compound which showed no perceptible deterioration was selected as a standard and will be specified in placing orders for eye shades in the future.

#### **Cooperation with Technical Societies, Manufacturers, and Consumers.**

The Bureau is actively cooperating with the American Society for Testing Materials and with a number of testing laboratories representing manufacturers and large consumers in the development of specifications for rubber goods, such as insulated wire, rubber hose, rubber belting, valves, insulating and friction tape, etc.

Work of this sort is of a distinct value in keeping the Bureau in touch with the progress of manufacturing practice and the Bureau's research laboratory serves a very useful purpose in affording facilities for careful and accurate determinations of the physical properties of rubber.

#### **Assistance Rendered Government Departments.**

The Bureau acts in an advisory capacity for the various Government departments in furnishing specifications for miscellaneous materials and in making reports covering the results of tests in connec-

tion with supplies furnished on contract or submitted with competitive bids. The following instances illustrate the nature of this service:

The Bureau assisted in the preparation of specifications for rubber dredging sleeves by request of the Chief of Engineers, War Department.

A test for the resistance of oils to emulsification, which was developed at the Bureau, has proved satisfactory in specifications and has been adopted by the Panama Canal.

Thirty-two samples of inner tubes for automobile tires were submitted under competitive bids to the Post Office Department. The Bureau's report covering the results of physical and chemical tests of these tubes was used as a basis for awarding the contract.

Fourteen samples of rubber bands were tested for the Post Office Department, the General Supply Committee, and the Panama Canal. The Bureau's reports were used as a basis for the award of contracts.

#### **Information Furnished on Physical Tests of Rubber and Leather.**

Numerous requests have been received for information regarding the testing of rubber and leather and for the results of the Bureau's experimental work along these lines. As a rule, these requests come from the more progressive manufacturers who realize the advantages of reliable laboratory tests in developing their products and in maintaining uniformity in the quality of their raw and manufactured materials. In the majority of cases referring to rubber the desired information is supplied by reference to Bureau Circular No. 38, third edition, which illustrates and describes the apparatus and methods of testing rubber developed at the Bureau and also gives the results of experimental work in determining the physical properties of rubber.

#### **Special Tests of Miscellaneous Materials.**

There have been made during the past year 136 special tests, some of which were of an experimental nature requiring detailed attention and special equipment. Under this head may be mentioned the following:

Samples representing 500 feet of cotton rubber-lined hose purchased by the District of Columbia Fire Department were tested according to specifications prepared expressly for this material. Five samples of cotton rubber-lined fire hose were tested for the Panama Canal and 20 samples of linen fire hose were tested for the Office of the Superintendent, State, War and Navy Building.

Twelve samples of tanner shark and other fishskins were tested for strength and stretch. In one case many tests were made to determine the relative tensile properties at all points of the skin.

Three tanned calfskins were tested to determine the relative strength and stretch at all points of the hides.

Twenty-four samples of sole leather were tested under different conditions to determine their wearing quality.

Eighteen samples of different rubber compounds were tested for wearing quality.

Three samples of rubber hospital sheeting were tested for a manufacturer of this material.

A sample of pneumatic tire for use in connection with airplanes was tested for the Signal Corps of the War Department.

A sample of cotton rubber-lined fire hose was tested for the Department of Engineering, city of Hartford, Conn.

#### **Tests of Miscellaneous Materials.**

During the past year a total of 956 miscellaneous samples were tested, including the following items, which are representative of the materials handled: Rubber hose, 156; packing (asbestos, rubber, etc.), 200; rubber-covered wire, 189; leather belting, 47; canvas belting, 25; hack-saw blades, 122; and sole leather, 19.

The majority of these tests were made at the request of the Panama Canal and the General Supply Committee, in connection with contracts for Government purchases. Numerous tests were also made for the various Government departments and for manufacturers who lack the special facilities offered by the Bureau's laboratory.

#### **Comparison of Cotton and Wool Flags.**

A series of exposure tests have been made upon flags made from cotton and from worsted bunting to determine under what conditions it would be desirable to use the cheaper cotton material. The large and increasing consumption of bunting has made this question one of considerable importance. This investigation has been completed and the results will be published soon in a technologic paper of the Bureau entitled "Comparative Durability of Cotton and Wool Flags."

#### **Identification of Textile Fibers.**

Any scientific examination of a textile material presupposes a knowledge of the kind or kinds of fiber of which it is composed. This information, when lacking, may usually be best obtained by a microscopical examination. The Bureau has recently purchased a photomicrographic outfit which will greatly facilitate and improve this branch of the work.

#### **Sewing-Machine Stitches.**

Two of the more common types of stitches have been compared as to the relative ability of the resulting seams to resist breaking when subjected to tension applied perpendicularly to the direction of the seam. Tests were made both with the seam intact and with one or both of the constituent threads cut at the middle of the test piece. Technologic Paper No. 96, Comparative Tests of Stitches and Seams, gives in detail the methods of test used and the results obtained.

#### **Tensile Strength of Fabrics.**

One of the most useful methods of estimating the quality or durability of a fabric is to study the effect upon it of tension applied in the direction of each of its sets of threads. The rate of stretching under uniformly increasing tension is of particular interest in connection with fabrics to be used for structural purposes. A curve-drawing apparatus has been designed and attached to one of the Bureau's strength-testing machines for automatically registering this effect. There has also been designed a new testing machine which

may be manipulated at various speeds, giving a large variety of methods of loading. This machine will be found useful in studying the effect upon the tensile properties of fabric of alternations in the manufacturing processes. For securing the desired atmospheric condition for this work an instrument has been installed which automatically regulates the moisture.

### **Textile Conference.**

During May the second conference relating to the technical consideration of textile materials was held at this Bureau. A large number of technical and scientific men attended the meeting and the papers presented were very well received. A full report of the proceedings will be published by the Bureau shortly. It is expected that a similar meeting will be held next year.

### **Information Furnished Regarding Textiles and Textile Testing.**

A great many requests have been received by the Bureau for information regarding the testing and properties of textile materials. These inquiries are very often suggestive of new phases of research.

The various departments of the Government require specifications to regulate purchases and, when desired, this Bureau assumes the responsibility of writing these specifications.

### **Testing of Textiles.**

This Bureau has made tests of a routine nature upon 3,492 samples of textile materials. Included in these materials were a large variety of commercial grades and kinds of fabrics, twine, thread, yarn, waste, and loose fiber.

### **Buttermilk Casein as a Paper-Sizing Material.**

Casein is the principal proteid in milk and as such has a high food value. Cheese contains both the fat and the casein of the milk, butter contains the fat only. Since the manufacture of butter is more profitable than the manufacture of cheese, there is always a considerable quantity of both skim milk and buttermilk. The skim milk and buttermilk contain the casein of the original milk. The casein may be recovered by various processes, and it finds an extensive use as the adhesive by which a film of clay or other similar material is bound to a sheet of paper. The finished paper, known as coated paper, has a very smooth surface well adapted for the reproduction of photographs and for the printing of high-grade illustrations.

The casein investigation was started at the request of the Dairy Division of the Bureau of Animal Industry, Department of Agriculture, and is a joint investigation with it. Its end of the problem has been a study of the production of skim and buttermilk caseins, while the application of casein in the paper industry is being developed by the Bureau of Standards.

Almost all paper makers express a strong preference for the French caseins. This does not seem to be due to any necessary inferiority of the domestic product, but rather to the fact that domestic producers do not turn out a uniform product. Different users express a preference for casein made in different ways. Casein made from buttermilk or from a mixture of buttermilk and skim milk can be



used, but does not seem to be a standard product. Certain mills claim that they find some of it suitable. Others have not been able to use it at all. Since the origin of a casein can not be told definitely from its appearance, it is likely that the expressed opinions of the industry can not be taken as final. Any investigation which will tend to bring together the user and the manufacturer of casein; to improve the domestic product, both as to quality and to uniformity; and to encourage the use of milk which would otherwise be wasted can not fail to be of benefit. At this time it must not be overlooked that this product has a distinct food value and that it should be the aim of the manufacturer to use for this purpose milk which could not be used for food under the existing circumstances.

The particular purpose of the investigation is to establish the most suitable methods for the production of skim milk and buttermilk caseins, devise methods for testing the finished product, and to study the best methods for its use in the paper industry.

#### **Domestic Clays in the Paper Industry.**

The examination of imported and domestic china clays for use as a paper filler and as a coating material for paper is being continued. Its purpose is to determine those characteristics which produce the best results in the paper industry. The clays are being examined, both chemically and physically, together with tests to determine the rate of slaking, color of the clay, and water mixture, etc. It is the purpose of this investigation to replace the imported clay by a suitable domestic clay.

#### **Paper-Testing Devices.**

The necessity for standard methods of testing materials has spread to the paper industry, and a demand has been created for testing devices, the results of which may be interpreted in terms of the quality of a paper to be used for a particular purpose. The testing devices now in use are not entirely satisfactory, as they are of the empirical type. Data from a series of comparative tests, using several of the well-known testing devices, have been secured and are now being compiled. Certain changes are also being made in these testing devices, together with a study of some of the more common faults found. The results of this investigation will place the testing of paper on a firmer basis and provide means for securing more accurate data relating to the quality of a particular paper.

#### **Utilization of Waste Paper for Remanufacture into Paper.**

The utilization of waste paper for remanufacture into white paper is growing in importance each year. At the present time over 25 per cent of all paper made is collected for remanufacture and a very large part of this material is used in making white papers. The present methods, however, are very wasteful in that a large percentage of the material is lost in the recovery process. It is the purpose of this investigation to study the present recovery methods, particularly with regard to the effect of the chemicals used and the loss due to overheating.

#### **Paper Bags for Shipping Cement, Lime, and Gypsum.**

The investigation to determine the most suitable paper for use in the making of cement, lime, and gypsum bags has been completed as

far as the laboratory tests are concerned. This work has involved a long series of tests, including all those tests regularly applied to paper, together with several tests especially devised for the purpose. The results so far are not such as will enable definite conclusions to be drawn. This is due to the fact that it has been impossible to make a satisfactory connection between the laboratory data and actual service conditions.

No reliable information could be secured from either the user or the manufacturer of bags, because no systematic tests were being made. In some cases bags that were condemned as being entirely unsatisfactory proved by a laboratory test to be of a high quality. The reverse of this has also been experienced and such conflicting conditions have made it difficult for the laboratory to put the proper interpretation upon the laboratory results. In several cases it has been shown that proper bags were being improperly used, thereby causing excessive breakage and condemnation of the bag. These conflicting data have necessitated the development of a service test for the laboratory by which it is hoped to interpret the laboratory data into actual service conditions.

#### **Manufacture of Filter Paper.**

Filter paper is used in all chemical laboratories and in large quantities in industrial work for filtering out fine suspended particles from a liquid. The highest quality of filter paper is imported and under present conditions it is almost impossible to obtain it. Many inquiries have been received at the Bureau, asking if it was possible to obtain domestic filter papers of suitable quality. None is made in this country and therefore an investigation as to its manufacture has been started at the Bureau. Samples of the best grades of imported papers have been obtained and they are being subjected to a series of tests to determine their physical and chemical properties.

Filter papers must have a very low percentage of ash, a rapid rate of filtering, and must be free of certain constituents. The chemical treatment after manufacture is highly important and, so far, this final chemical treatment has not been satisfactorily worked out. It is proposed to continue the investigation along this line, as the final chemical treatment determines the quality of the paper.

#### **Information Furnished Concerning Paper.**

Assistance was rendered in the preparation of definite specifications covering the general needs of the various branches of the Government service. Work of this kind is continuous as there is a constant demand for pulp and paper products to meet special uses and the constantly changing requirements of the Government service. Continuous assistance is required by the Congressional Joint Committee on Printing, the General Supply Committee, and the Post Office, War, and Navy Departments.

Inquiries covering a very wide range have been received from the pulp and paper industry. While most of these have been handled by mail, in many cases the persons interested have visited the Bureau in order to study the methods in use at first hand. Among the visitors have been chemists and engineers of large manufacturing establishments, representatives of trade associations, and persons

engaged in the paper business. Several of them have been interested particularly in the experimental paper-making equipment of the Bureau, with a view to introducing something of a similar nature in their own establishments.

The Bureau always endeavors to aid manufacturers who may have difficulty in making satisfactory deliveries on Government contracts and many suggestions have been made during the year to such manufacturers. Many requests for the standard samples and specifications used by the Government have been received and complied with, and in addition to this many specifications have been prepared to meet the requirements of paper for special uses.

Attention has been given to the utilization of certain waste materials, due to the large number of such inquiries continually being received.

Many visitors have been shown through the paper laboratory and the nature of the work explained to them. This has helped to spread among the trade a knowledge of the facilities of the Bureau and in many cases has shown the manufacturer where the Bureau could be of material assistance to him.

#### **Paper Testing.**

During the past year the Bureau has tested 3,095 samples of paper, 3,033 for the Government Printing Office and the Government departments and 62 for public and private interests.

### III. OFFICE.

#### Publications.

During the fiscal year just ended the Bureau issued 67 publications, of which 61 were new and the remainder revised editions. Approximately 56 publications were reprinted, owing to the large demand for those papers. The new publications included 4 numbers of the Bulletin of the Bureau, which completes the thirteenth volume of the scientific papers. There were also issued 28 new scientific papers, 20 new technologic papers, 9 new circulars, and 3 new miscellaneous publications.

The following new scientific papers were issued during the year: A Study of Inductance of Four-Terminal Resistance Standards; Sensitivity and Magnetic Shielding Tests of Thomson Galvanometer for Use in Radiometry; Volume Effect in Silver Voltameter; Constants of Spectral Radiation of Uniformly Heated Inclosure or So-called Black Body, II; Summary of Experiments on Silver Voltameter at Bureau of Standards and Proposed Specifications; Determination of Aluminum as Oxide; Calculation of Planck's Constant  $C_2$ ; Wheatstone Bridges and Some Accessory Apparatus for Resistance Thermometry; Damping of Waves and Other Disturbances in Mercury; A Variable Self and Mutual Inductor; System of Remote Control for Electric Testing Laboratory; International System of Electric and Magnetic Units; Saccharimetric Normal Weight and Specific Rotation of Dextrose; Freezing Point of Mercury; Determination of Degree of Uniformity of Bars of Magnetic Standards; Thermoelectric Measurement of Critical Ranges of Pure Iron; Study of Electromagnet Moving Coil Galvanometers for Use in Alternating-Current Measurements; Standard Substances for the Calibration of Viscometers; An "Average Eye" for Heterochromatic Photometry, and Comparison of a Flicker and an Equality-of-Brightness Photometer; Emissivity of Straight and Helical Filaments of Tungsten; Aneroid Calorimeter for Specific and Latent Heats; Wave Lengths of Stronger Lines in Helium Spectrum; Relative Sensibility of Average Eye to Light of Different Colors and Some Practical Applications to Radiation Problems; Calculation of Constants of Planck's Radiation Equation; Extension of Theory of Least Squares; Luminous Radiation from Black Body and Mechanical Equivalent of Light; Experimental Study of Fahy Permeameter; Note on Electrical Conductors in Metals at Low Temperatures; Reflecting Power of Tungsten and Stellite.

The following new technologic papers were issued: Density and Thermal Expansion of American Petroleum Oils; Properties of Calcium Silicates and Calcium Aluminates Occurring in Normal Portland Cement; Properties of Some European Plastic Fire Clays; Constitution and Microstructure of Porcelain; Liquid-Measuring Pumps; Failure of Brass: 1, Microstructure and Initial Stresses in Wrought Brasses of the Type 60 Per Cent Copper and 40 Per

Cent Zinc; Failure of Brass: 2, Effect of Corrosion on Ductility and Strength of Brass; Failure of Brass: 3, Initial Stress Produced by the "Burning in" of Manganese Bronze; Manufacture and Properties of Sand-Lime Brick; Resistance of an Oil to Emulsification; Recovery of Paraffin and Paper Stock from Waste Paraffin Paper; Studies on Paper Pulp; Specific Gravity Balance for Gases; Structure of Coating on Tinned Sheet Copper in Relation to a Specific Case of Corrosion; Temperature Measurements in Bessemer and Open-Hearth Practice; Measurement and Specification of Physical Factors which Determine Saturation of Certain Tints of Yellow; Glasses for Protecting Eyes from Injurious Radiations; Effusion Method of Determining Gas Density; Durability of Cement Drain Tile and Concrete in Alkali Soils; Comparative Tests of Stitches and Seams.

The following new circulars were issued: Proposed National Electrical Safety Code; Standards for Electric Service; Electric Units and Standards; Specifications and Tolerances for Weights and Measures and Weighing and Measuring Devices; Specifications for and Methods of Testing Soaps; Specification of Transparency of Paper and Tracing Cloth; Rules and Regulations for Enforcement of Lime-Barrel Act; Gas Calorimeter Tables; Standard Samples for Thermometric Fixed Points.

The following miscellaneous publications were issued: Some Technical Methods of Testing Miscellaneous Supplies; Annual Report of the Director of the Bureau of Standards for the Fiscal Year ended June 30, 1916; Eleventh Annual Conference on Weights and Measures of the United States.

#### Technical Library.

The library contained at the close of the fiscal year 14,929 accessioned volumes, all of a scientific and technical character with the exception of a few law books. Two hundred and ninety-seven scientific and technical periodicals are currently received. This number does not include 94 (77 of which are German) not received on account of the war.

#### Personnel.

During the year the Bureau staff comprised 252 statutory appointees and about 265 engaged in researches and investigations specially authorized by Congress. The statutory positions included 149 scientific positions, 37 office assistants, 41 engaged in the operation of the plant, and 25 in construction work. There were 778 personnel changes during the year. These included 204 separations from the Bureau, of which 114 were resignations. There were 219 promotions and 338 appointments during the year.

#### Appropriation Statements.

The following statement shows the amount and object of each appropriation provided for the Bureau for the fiscal year 1917, the disbursement during the year, the amount of unfilled and unpaid orders at the close of the year, and the unexpended balance remaining at the close of business June 30, 1917:

Appropriation.	Total appropriation.	Disbursement.	Liability.	Balance.
Salaries.....	\$311,720.00	\$277,357.70	\$12,479.11	\$21,883.19
Equipment.....	50,000.00	33,276.48	16,723.52	.....
General expenses.....	28,500.00	19,104.30	9,187.94	207.76
Repairs and alterations.....	5,000.00	1,379.21	3,387.03	233.76
Grounds.....	6,000.00	2,803.62	3,152.93	43.45
High-potential investigation.....	15,000.00	12,822.86	1,101.83	75.31
Refrigeration constants.....	15,000.00	14,394.70	575.95	29.35
Testing structural materials.....	100,000.00	90,034.04	9,815.03	150.93
Testing machines.....	30,000.00	25,254.75	4,547.03	198.22
Investigation of fire-resisting properties.....	25,000.00	18,355.12	6,644.88	.....
Public-utility standards.....	40,000.00	37,665.56	2,089.38	242.06
Railway materials.....	15,000.00	12,660.74	2,322.07	17.19
Testing miscellaneous materials.....	20,000.00	17,408.56	2,512.88	78.56
Radio research.....	\$14,459.71	12,611.20	1,644.81	303.70
Color standardization.....	10,000.00	6,661.30	3,324.08	14.62
Clay products.....	10,000.00	9,212.13	787.87	.....
Physical constants.....	5,000.00	2,932.50	1,694.08	373.42
Standardizing mechanical appliances.....	10,000.00	2,729.09	7,114.16	156.75
Testing railroad scales, etc.....	40,000.00	31,861.32	8,138.68	.....
Radio laboratory.....	50,000.00	1,334.76	733.80	47,631.44
Chemical laboratory.....	200,000.00	194,699.86	5,034.48	265.66
Equipping chemical laboratory.....	35,000.00	11,385.39	23,473.68	140.93
Total.....	1,035,679.71	836,848.19	126,485.22	72,346.30

\* Includes reimbursement of \$4,450.71.

The following statement shows the condition of the appropriations for the two preceding fiscal years at the close of business June 30, 1917:

## FISCAL YEAR 1915.

Appropriation.	Total appropriation.	Disbursement.	Liability.	Balance.
Salaries.....	\$293,500.00	\$278,379.16	.....	\$15,120.84
Equipment.....	\$57,311.33	55,198.58	\$1,127.07	885.68
General expenses.....	27,000.00	25,965.04	364.00	670.96
Repairs and alterations.....	2,000.00	1,998.52	.....	1.48
Grounds.....	6,000.00	5,998.74	.....	1.26
High-potential investigation.....	15,000.00	14,984.96	.....	15.04
Refrigeration constants.....	15,000.00	14,997.89	.....	2.11
Testing structural materials.....	100,000.00	99,759.68	53.95	184.37
Testing machines.....	30,000.00	29,853.15	117.02	29.83
Investigation of fire-resisting properties.....	25,000.00	24,650.37	.....	349.63
Public-utility standards.....	25,000.00	23,230.21	1,410.33	359.36
Railway materials.....	15,000.00	14,839.06	110.00	50.94
Testing miscellaneous materials.....	20,000.00	19,920.64	.....	79.36
Testing railroad scales, etc.....	40,000.00	39,831.07	100.06	78.85
Total.....	670,811.33	649,597.17	3,262.45	17,931.71

\* Includes reimbursement of \$7,311.33.

## FISCAL YEAR 1916.

Salaries.....	\$268,780.00	\$283,079.84	.....	\$15,700.16
Equipment.....	80,000.00	47,723.70	\$1,666.24	610.06
General expenses.....	27,000.00	26,656.01	263.20	80.79
Repairs and alterations.....	2,000.00	1,985.88	.....	14.12
Grounds.....	6,000.00	5,901.11	1.58	97.31
High-potential investigation.....	15,000.00	14,799.82	152.00	48.06
Refrigeration constants.....	15,000.00	14,923.23	.....	76.77
Testing structural materials.....	100,000.00	99,437.16	250.37	312.47
Testing machines.....	30,000.00	27,634.65	2,264.51	100.84
Investigation of fire-resisting properties.....	25,000.00	24,879.78	82.00	38.22
Public-utility standards.....	25,000.00	24,756.29	3.00	240.71
Railway materials.....	15,000.00	14,427.15	262.51	280.34
Testing miscellaneous materials.....	20,000.00	19,999.96	.....	.04
Current-meter testing tank.....	3,000.00	2,998.34	.....	1.66
Heating system, north laboratory.....	3,000.00	2,520.54	.....	479.46
Radio research.....	\$12,808.74	12,140.49	.....	168.25
Testing railroad scales, etc.....	40,000.00	27,728.78	12,271.22	.....
Total.....	687,088.74	661,592.83	17,246.63	18,249.28

\* Includes reimbursement of \$2,808.74.

## Summary of Tests.

The work of the Bureau involves, among other things, a large amount of testing of standards, measuring instruments, and materials. It involves primarily the investigation of the scientific principles underlying the tests, the studying of existing methods, and the development of new standard tests of determinate accuracy. For each test a reasonable fee is charged, except when made for the National or State Governments.

During the fiscal year 1917 the Bureau made 155,848 tests and inspected 1,782,044 incandescent lamps at various factories for other departments of the Government. Of the total tests, 145,939 were for the Government and 9,909 for the public. The testing was distributed as follows, according to the nature of the tests: Length measures, 387; mass, 3,746; capacity, 1,189; temperature, 15,763; hydrometry, 926; miscellaneous, 23; optical, 1,365; time, 69; electrical, 1,290; photometry, 2,864; chemical, 13,170; engineering (miscellaneous), 511; engineering (instruments), 482; structural materials, 107,078; paper and textiles, 5,583; metallurgical, 1,402. The estimated fees amounted to \$194,778.14, of which \$17,765.47 were collected on account of tests for the public. The fees noted for Government tests are included merely for comparison purposes, as no charge is made for tests performed for the National or State Governments.

## NUMBER AND VALUE OF TESTS COMPLETED, FISCAL YEAR ENDED JUNE 30, 1917.

Nature of test.	For Government.		For public.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Length.....	197	\$491.80	190	\$427.95	387	\$919.75
Mass.....	2,309	27,554.85	1,437	606.00	3,746	28,160.85
Capacity.....	900	455.25	289	278.05	1,189	733.30
Optical.....	1,327	1,980.50	38	173.00	1,365	2,153.50
Hydrometry.....	650	681.15	276	377.60	926	1,058.75
Miscellaneous.....	16	60.00	7	8.50	23	68.50
Time.....	1	100.00	68	322.50	69	422.50
Temperature.....	12,850	2,475.07	2,913	3,124.10	15,763	5,599.17
Electrical.....	736	3,684.77	554	3,387.37	1,290	7,072.14
Photometry <sup>a</sup> .....	2,568	9,411.50	296	625.50	2,864	10,037.00
Chemical <sup>b</sup> .....	10,047	79,688.40	3,123	6,192.00	13,170	85,880.40
Physical and mechanical tests:						
Engineering, miscellaneous.....	481	1,773.00	30	65.50	511	1,838.50
Engineering instruments.....	421	2,150.50	61	400.00	482	2,550.50
Structural materials.....	106,627	31,281.50	451	1,359.90	107,078	32,641.40
Paper and textiles.....	5,417	10,580.00	166	313.50	5,583	11,193.50
Metallurgical.....	1,392	4,344.38	10	104.00	1,402	4,448.38
Total.....	145,939	177,012.67	9,909	17,765.47	155,848	194,778.14

<sup>a</sup> In addition, the Bureau inspected 1,782,044 incandescent lamps at various factories for other departments of the Government, the fees for which would amount to \$8,910.22 additional.

<sup>b</sup> Of these tests, 7,633, amounting to \$64,331, were chemical tests made on structural materials.

## Metric System.

The general use of the metric system in Europe and the need for supplies and equipment in the metric system has called for a greatly increased use by American manufacturers. Manufacturers and exporters in large numbers have appealed to the Bureau for assistance and information concerning the metric system and the equivalents.

A large number of charts and circulars have been distributed for this purpose.

In addition, the movement of the troops to Europe has brought forth an extended demand for information as to the metric system for the officers and men in both the Army and Navy. The battle-ships, cantonments, arsenals, and the various bureaus of the War Department have been supplied at their request with metric literature.

A very large distribution of metric system publications has gone to the public schools of the country at their request. This is especially large in the case of public schools located in manufacturing districts.

### **Exhibits of the Activities of the Bureau.**

Frequent requests are received from various organizations for the Bureau to make exhibits of its activities at expositions or conventions. While it is recognized that such publicity as is thereby given increases the usefulness to the public of the Bureau work and publications, it has not been possible to comply with all of such requests owing to lack of funds and personnel available for such work. In fact, under present war conditions it will probably not be feasible to participate in any such exhibits. However, when normal conditions are restored, funds should be especially provided for the proper preparation and organization of exhibits typical of the activities of the Bureau, such work to be put on a sure and permanent basis. The excellent results obtained for past exhibits indicate that a reasonable expenditure will be fully justified.

Among the exhibits in which the Bureau has participated during the year are the following: Second Exposition of Chemical Industries, New York, N. Y., September 25 to 30, 1916; American Chamber of Commerce, Washington, D. C., January 30 to February 2, 1917; American Metric Association, New York, N. Y., December 26 to 28, 1916; Aeronautic Exposition, New York, N. Y., February 8 to 13, 1917; and the Industrial and Export Exposition, Springfield, Mass., June 23 to 30, 1917. The metric exhibit prepared for the American Metric Association has been permanently installed in the American Museum of Natural History.



#### IV. RECOMMENDATIONS.

##### **Increase in Scientific Staff.**

The demands upon the Bureau in connection with the scientific work of the country, the industries, and especially the military departments of the Government, have grown by leaps and bounds. The Bureau is not only neglecting much work that should be done, but has been compelled to do many things in a temporary and superficial manner. This has been true especially during the past three years; nevertheless, every effort has been made to utilize the resources of the Bureau to the greatest possible extent in assisting the public to meet these new conditions and in aiding the military departments in the application of science to their problems. The demand on the part of the industries for accurate and reliable scientific data, a rapidly increasing one, has never been as great nor as important as at present, and such data will be of particular value at the conclusion of the present war. A conservative estimate for the additional services needed has been prepared and will be submitted. This estimate has been based solely upon the most urgent and pressing needs of the Bureau. It is hoped that Congress will recognize the importance of this increase and provide accordingly.

##### **Increases in Salaries.**

Never has the demand for scientific and technically trained men been as great as at present. This has resulted in the loss of many well-trained men in the Bureau's staff. The time has come when some of the salaries paid such experts must be increased or their services dispensed with. This can not be done without a loss in quality and the deterioration of the high standard of the Bureau's work.

##### **Additions in the Clerical, Operating, and Construction Staffs.**

The clerical staff is entirely inadequate and should be increased to meet the present urgent needs, which have greatly multiplied on account of the new demands made upon it. This is true especially in the care of property, files, records, and correspondence.

The addition of the chemical building, finished a year ago, and two new buildings now in process of erection, to be completed before June 30, 1918, make it absolutely necessary to increase the operating force of the mechanical plant.

The testing and investigational work of the Bureau is greatly handicapped by the lack of sufficient instrument workers. Estimates will be submitted for additional assistance of this kind.

##### **Increases in Special Funds.**

Increases are urgently needed in several of the special funds under which the Bureau is carrying on important work. The structural material fund is barely sufficient to care for the testing work of the

Government service. It should be increased by at least 50 per cent in order that the Bureau may undertake more investigational work needed by the Government service and by the public. The importance of this work can hardly be overestimated, not only from the standpoint of economy and efficiency in the structural work of the Government, but from that of the efficient and economical use of these materials on the part of the public and the military services.

The Bureau's work in connection with public utilities has proven of the utmost importance. The fund available is insufficient to cover more than two or three problems. The present appropriation might well be increased several fold; it would meet with the hearty approval of all public-service and municipal bodies having to do with the regulation of public utilities. It would contribute greatly to better service on the part of public utilities, as well as to the conservation of life and property.

The enormous annual loss of property by fire emphasizes the great necessity for a better knowledge of the fire-resisting properties of materials and construction. To be of value such work must be carried on with specimens commensurate with those used in practice. The Bureau's work in this direction has been well organized and much of the apparatus constructed. However, funds are needed for additional equipment as well as materials upon which to work, which in such cases are necessarily expensive; therefore, this fund should be increased to at least threefold its present value.

An increase is needed in the fund for miscellaneous materials, due to the growing tendency on the part of the Government to buy such materials according to properly prepared specifications and tests.

During the past year the Bureau submitted an estimate to provide for the determination of physical constants, a part of which was approved by Congress. These constants are of the utmost value in scientific and industrial work. Their determination involves the most difficult work in physics and chemistry. The Bureau should ever be the source of accurate and authoritative values of this kind and ample provision should be made for their determination.

The funds available during the coming year for the investigation of mechanical appliances are insufficient to meet even the needs of the Government service alone. This is true especially of the large number of military appliances and devices that have been submitted to the Bureau by the military departments. Here again, as in the purchase of materials, the Government is purchasing machinery and all sorts of devices in accordance with carefully prepared specifications, and suitable tests are made before their acceptance. The standard of performance in such cases and the methods of measuring the same are equally important to the manufacturer and to the public. This fund should be increased to two or three times its present value.

In general, it has been thought best to submit only such estimates as are urgently needed to care for present work rather than to enter new fields. However, several exceedingly important cases have arisen for which estimates will be submitted. The work of the Bureau in connection with the investigation of optical glass has proven of the utmost importance, both in military and scientific work, and in view of the necessity for the development of important kinds of glass which have heretofore been imported, an increase in this special fund will be submitted.

Estimates will be submitted for work in connection with the following: Standard materials; textiles, paper, leather, and rubber; electrodeposition metals; research fellowship; metallurgical research; chemical reagents; illumination investigation; radio activity; magnetic analysis; insulating investigation; and sea-water concrete investigation. All of these investigations are urgently needed in connection with the scientific, industrial, and military development of the country; in most cases the results obtained will be applicable to all of these interests.

#### **Buildings.**

Attention is again directed to the urgent necessity of placing the structural material work of the Bureau in permanent quarters. An estimate for a suitable site, building, and additional equipment has several times been submitted and is again presented. It is earnestly hoped that favorable action will be taken during the coming year.

#### **New Refrigerating Machine.**

A new machine to produce the refrigeration needed in laboratories is essential. The present machine was installed in 1904 and was well suited to the conditions then existing. However, the growth of the Bureau's work and the addition of new buildings make an increase of capacity imperative, while these and other conditions indicate marked economy to be obtained from a motor-driven compression machine instead of the present absorption type.

Respectfully,  
To HON. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*

S. W. STRATTON, *Director.*

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**REPORT**  
**OF THE**  
**DIRECTOR OF THE CENSUS**

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511



# REPORT

OF THE

## DIRECTOR OF THE CENSUS.

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DEPARTMENT OF COMMERCE,  
BUREAU OF THE CENSUS,  
*Washington, October 1, 1917.*

SIR: There is submitted herewith the following report upon the organization of the Bureau of the Census, its operations during the fiscal year ended June 30, 1917, and the work now in progress:

### ORGANIZATION AND SCOPE OF WORK.

Since my last report the organization of the Census Bureau has been changed by the creation of a new division, the division of cotton and tobacco statistics (provided for by the act of May 10, 1916); by the reestablishment of the division of agriculture, which went temporarily out of existence at the close of the Thirteenth Census period; and by the appointment of an additional chief statistician (authorized by the legislative, executive, and judicial appropriation act approved March 3, 1917) to have general authority and supervision over the work of these two divisions.

### DUTIES OF DIVISIONS.

The diagram on page 514 shows graphically the present organization of the Bureau. The work of the several divisions may be briefly stated as follows:

*Administrative division.*—General supervision of personnel, including appointments, promotions, transfers, etc.; handling of general correspondence; distribution of publications; preparation of press summaries; other work not belonging especially to any other single division.

*Population division.*—Collection, compilation, and preparation for publication of decennial statistics relating to population (including occupations) and religious bodies and of special statistics pertaining to marriage and divorce.

*Division of manufactures.*—Collection, compilation, and preparation for publication of quinquennial statistics pertaining to manufactures and to electrical industries (electric light and power plants, street and electric railways, telegraphs and telephones, and electric fire-alarm and police-patrol signaling systems); and of decennial statistics of mines, quarries, and oil and gas wells, of water transportation, and of fisheries (in cooperation with the Bureau of Fisheries).



*Division of vital statistics.*—Collection, compilation, and preparation for publication of annual statistics of births and deaths in States and cities having adequate registration systems, and preparation of special reports presenting particular phases of vital statistics, such as "Life Tables" and "Mortality from Cancer."

*Division of statistics of cities.*—Collection, compilation, and preparation for publication of annual financial and general statistics of cities having more than 30,000 inhabitants; of annual financial statistics of States; and of decennial statistics of wealth, public indebtedness, and taxation.

*Division of agriculture.*—Collection, compilation, and preparation for publication of decennial statistics relating to agriculture.

*Division of cotton and tobacco statistics.*—Collection, compilation, and preparation for publication of statistics relating to cotton ginned to specified dates; monthly statistics of cotton consumed, imported, exported, and on hand, and of active cotton spindles; monthly statistics pertaining to cotton seed and its products; quarterly statistics relating to cotton fiber consumed in the manufacture of explosives; quarterly statistics of raw cotton consumed in the manufacture of absorbent and medicated cotton; annual statistics of cotton production and distribution; quarterly statistics of leaf tobacco held by manufacturers and dealers; and preparation of an annual bulletin giving statistics of leaf tobacco held at the beginning of each quarter, together with statistics as to acreage, production, imports, exports, consumption, etc.

*Division of revision and results.*—Compilation and preparation for publication of the following: Statistics of special classes—such as Negroes, deaf and dumb, blind, paupers, inmates of benevolent institutions, insane and idiotic, and prisoners and juvenile delinquents—from data gathered at decennial censuses; Official Register of the United States (issued biennially); and statistics relating to Federal employees; and performance of miscellaneous work in connection with the printing of all census publications.

*Geographer's division.*—Maintenance of records as to boundaries of supervisors' and enumerators' districts and creation of new districts where needed; maintenance of records as to changes in boundaries of counties, precincts, and municipalities; decennial preparation of Statistical Atlas of the United States; preparation of maps, charts, and diagrams illustrating statistics in census publications; searching of old census records for information in regard to ages and other data concerning individuals; and preparation of population estimates between census years.

#### OUTLINE OF WORK DONE DURING A DECADE.

The work of the Census Bureau is laid out in 10-year cycles and comprises inquiries made at intervals varying in length from 2 weeks to 10 years. The following is an outline of the various lines of work carried on during a decade:

*The decennial census.*—The taking of the decennial census, which covers the subjects of population, agriculture, manufactures, and mines and quarries (including oil and gas wells), is the chief function of the Bureau. The reports relating to these subjects present the statistics in great detail and are issued not only in the form of large



bound volumes but also as numerous paper-bound bulletins, each of which relates to a particular State of the Union or to a particular phase of an inquiry, such, for example, as some one manufacturing industry. During the taking of a decennial census the Bureau's field force comprises from 70,000 to 80,000 supervisors, enumerators, and special agents; and during the compilation of the data obtained its office force numbers, at times, from 3,500 to 4,000.

*Other decennial inquiries.*—Under authority contained in the act of Congress establishing the permanent Census Bureau (approved March 6, 1902), and in various acts amendatory thereof or supplementary thereto, the Census Bureau makes decennial investigations in regard to dependent, defective, and delinquent classes: wealth, public indebtedness, and taxation; religious bodies; transportation by water; and fisheries (in cooperation with the Bureau of Fisheries).

The decennial investigations relating to dependent, defective, and delinquent classes—inmates of benevolent institutions, the blind, the deaf, insane and feeble-minded in institutions, paupers in almshouses, and prisoners and juvenile delinquents—are made for the years in which the decennial censuses of population, agriculture, etc., are taken, and a part of the data are collected by the census enumerators, the remainder being obtained by correspondence. The reports, however, are not included in those of the decennial census but are issued after the close of the census period, which terminates on June 30 of the second year following that in which the census is taken. The last census of wealth, public indebtedness, and taxation related to the years 1912 and 1913; the current inquiries in regard to religious bodies and transportation by water relate to the year 1916; and the last census of fisheries covered the year 1908.

*Quinquennial inquiries.*—These comprise the censuses of manufactures and electrical industries. The manufactures inquiry forms a part of each decennial census, and in addition a similar inquiry is made in the fifth year following that in which the decennial census is taken. The current investigation relating to electrical industries covers the calendar year 1917.

*Biennial preparation of Official Register of the United States.*—Once in two years the Census Bureau compiles the Official Register of the United States. The edition for July 1, 1917, is now in course of preparation.

*Annual inquiries.*—The annual inquiries conducted by the Bureau of the Census cover births, deaths, finances of cities having over 30,000 inhabitants, "general" statistics of such cities, and finances of States.

*Quarterly tobacco statistics.*—At quarterly intervals (Jan. 1, Apr. 1, July 1, and Oct. 1) the Census Bureau issues, in post-card form, statistics as to stocks of leaf tobacco in the hands of manufacturers and dealers.

*Quarterly, monthly, and semimonthly cotton and cottonseed statistics.*—At quarterly intervals the Census Bureau issues, in the form of multi-graphed or mimeographed sheets, two series of reports, one relating to the consumption of cotton fiber in the manufacture of explosives and the other to the manufacture of absorbent and medicated cotton. At monthly intervals are published two series of post-card reports, one relating to cotton consumption, stocks, and spindles, and the other to cotton seed and its products. At slightly irregular intervals,

averaging about two weeks in length, are issued post-card reports showing the amounts of cotton ginned to specified dates, a total of 10 such reports being published during each ginning season. In addition, an annual bulletin on cotton production and distribution is published.

*Special and miscellaneous inquiries.*—Besides making the various inquiries specifically authorized by law, as enumerated above, the Bureau of the Census makes such special and miscellaneous inquiries as may be ordered by Congress, the President, or the Secretary of Commerce. In this category are included an investigation relating to marriage and divorce, made in 1907 and covering the 20-year period 1887–1906; a similar investigation, covering the calendar year 1916, now being made; and a special inquiry relating to the cost of city cartage.

#### OFFICE FORCE.

The following table shows the total statutory force of the Census Bureau and the number of clerical positions in each salary class, by fiscal years, beginning with the close of the last decennial census period:

Fiscal year.	Total force. <sup>a</sup>	Clerks, \$1,800.	Clerks, \$1,600.	Clerks, \$1,400.	Clerks, \$1,200.	Clerks, \$1,000.	Clerks \$800.
1912-13.....	610	11	20	32	300	83	87
1913-14.....	621	11	20	30	305	83	86
1914-15.....	599	11	20	38	308	83	85
1915-16.....	599	11	20	37	300	88	82
1916-17.....	562	15	25	40	283	83	81
1917-18.....	563	15	25	40	283	83	81

<sup>a</sup> Includes official and subclerical positions.

The increase of one for the present fiscal year as compared with the preceding one is accounted for by the creation of a new position of chief statistician.

The following statement shows the office and field employees on September 30, 1917:

#### OFFICIALS.

Director.....	SAM. L. ROGERS.
Chief clerk.....	THOMAS J. FITZGERALD.
Chief statisticians:	
Population.....	WILLIAM C. HUNT.
Statistics of cities.....	STARKE M. GREGAN.
Manufactures.....	EUGENE F. HARTLEY.
Vital statistics.....	WILLIAM H. DAVIS.
Agriculture, cotton and tobacco.....	WILLIAM L. AUSTIN.
Expert special agent in charge of revision and results.....	JOSEPH A. HILL.
Geographer.....	CHARLES S. SLOANE.
Expert chiefs of divisions:	
Administrative.....	TIMOTHY F. MURPHY.
Population.....	WILLIAM H. JARVIS.
Statistics of cities.....	EDWARD W. KOCH.
Manufactures.....	LEWIS A. CARRUTHERS.
Vital statistics.....	FRANK L. SANFORD.
Cotton and tobacco.....	JOHN F. DALY.
Revision and results.....	RICHARD C. LAPPIN.
Chief, mechanical laboratory.....	HARVEY J. ZIMMERMAN.
	HARRY H. PIERCE.
	E. M. LABOITEAUX.

## CLERICAL FORCE.

Stenographer, \$1,500.....	1	Clerks—Continued.	
Clerks:		\$1,000.....	83
Class 4.....	15	\$900.....	81
Class 3.....	25		
Class 2.....	40	Total.....	523
Class 1.....	283		

## SUBCLERICAL FORCE.

Skilled laborers:		Assistant messengers, \$720.....	5
\$900.....	2	Messenger boys, \$480.....	3
\$720.....	1		
Unskilled laborers, \$720.....	4	Total.....	18
Messengers, \$840.....	3		

## MECHANICAL LABORATORY FORCE.

Expert, \$2,000.....	1	Toolmaker, \$1,400.....	1
Expert, \$1,800.....	1	Tabulating mechanicians, \$1,200.....	4
Expert, \$1,800 (electrical).....	1	Pressman and machinist, \$1,200.....	1
Expert, \$1,600 (mechanical).....	1	General mechanic, \$1,000.....	1
Mechanician, \$1,600.....	1	Apprentice, \$800 (temporary).....	1
Mechanician, \$1,400.....	1		
Electrician, \$1,400.....	1	Total.....	15

## SPECIAL AGENT FORCE.

Expert special agents for general field work, etc.....	21
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## SUMMARY.

Officials.....	19	Mechanical-laboratory force.....	15
Clerical force.....	523	Special agents.....	21
Subclerical force.....	18		
		Total.....	601

In addition, there are employed throughout the cotton belt 767 local special agents to collect statistics of cotton. These agents perform their work only at intervals and are paid on a piece-price basis.

## LOSSES DUE TO LOW SALARY SCALE.

As explained in my last report, the Census Bureau labors under a great handicap by reason of its low average salary scale, which is causing many members of its force, including some of the most capable ones, to leave for more lucrative employment elsewhere, both in and outside the Government service. The extent of this handicap will be more readily understood and its seriousness will be more thoroughly appreciated when it is stated that out of the 563 official, clerical, and subclerical positions on the statutory roll of the Bureau only 98, or 17.4 per cent, pay salaries in excess of \$1,200 per annum, whereas in the other bureaus of the Department, considered as a whole, 39.9 per cent of the positions pay salaries higher than that figure. Furthermore, in 1912 (the latest year for which data are available) 36.1 per cent of the positions in all the executive departments combined, exclusive of those in the Bureau of the Census, carried rates of compensation greater than \$1,200 per annum. That is to say, the proportion of the Census force which receives more than \$1,200 per annum is less than half as great as the corresponding proportion for the remainder of the Department of Commerce and is also less than half as great as was the corresponding proportion in the remaining bureaus of all the departments combined five years ago.

The natural and inevitable result of this state of affairs appears in the fact that during the period from July 1, 1916, to September 30, 1917, the Census Bureau lost no fewer than 89 officials and employees, or nearly 16 per cent of its entire statutory force, including some of the most highly trained and valuable officers of the Bureau, whose services could ill be spared. The following cases are cited to illustrate the difference between the salaries received from the Census Bureau by some of the members of its force who have left since July 1, 1916, and the salaries they are now receiving:

In Bureau of Census.		Salary in present position.	In Bureau of Census.		Salary in present position.
Position.	Salary.		Position.	Salary.	
1 chief statistician.....	\$3,000	\$4,500	2 clerks.....	\$1,000	\$1,200
1 chief of division.....	2,000	4,000	6 clerks.....	900	1,600 (1)
1 clerk.....	1,800	3,000	1 skilled laborer.....	900	1,200 (5)
2 clerks.....	1,400	1,600			1,800
		2,000 (1)			
4 clerks.....	1,200	1,600 (1)			
		1,400 (2)			

It will be noted that one of the officials who left the Bureau is now drawing double the salary paid him here, and that the other official and a number of the clerks who left are receiving greatly increased compensation.

In its estimates of appropriations for the fiscal year 1915 the Census Bureau asked for a reclassification of its force, but no action was taken upon its request.

For the fiscal year 1917 Congress, at the request of the Bureau, provided for 13 new positions above \$1,200 and made a corresponding reduction in the number at that salary. This change, however, gave the Bureau only slight relief, since the number of \$1,200 positions on its roll still remained inordinately large and the number of places above \$1,200 inordinately small in proportion to the total.

The estimates for the current year called for an increase of 33 in the number of places with salaries above \$1,200, with a corresponding reduction in the number at that salary, the total number of positions being left the same. This would have necessitated an increase of only \$9,600, or less than 1½ per cent, in the total appropriation for salaries, but would have made possible a considerable number of well-deserved promotions and would thus have brought about a marked improvement in the morale of the Census Bureau's force. This increase, however, was not granted, and as a result the Bureau lost during the year a large number of its well-trained employees.

It is my duty to the Census Bureau and to the public to point out, in the most emphatic manner possible, that unless an immediate and pronounced improvement is effected the Census Bureau will be unable to maintain the standard of excellence which it has set for its publications; it will be unable to issue them as promptly as it is now doing; and, most important of all, it will be extremely difficult for it to make proper preparations for the Fourteenth Census.

## NEED OF LARGER FORCE.

Not only is the Bureau thus handicapped by its exceedingly low salary scale, but it suffers by reason of the inadequate size of its statutory force, which now numbers 563, whereas 10 years ago it was 636, or 73 more than the present number. A portion of this reduction (39 employees) was due to the removal of the Census Bureau to the Commerce Building and the resultant consolidation of a part of its force with that of the Department; but, making allowance for this consolidation, the Bureau is now operating with 34 fewer employees than it had 10 years ago. Its work, however, is materially greater at present than it was at that time, to some extent by reason of the addition, in 1912, of the semiannual (now quarterly) tobacco inquiry to the investigations regularly carried on by the Bureau, but more especially because of the general increase in the work along all lines, due in part to the growth of the country during the past decade and in part to the amplification and extension of certain inquiries, such as those relating to births, to mortality, to cotton and cotton seed, and to cities and States.

The increase in the vital-statistics work is worthy of particular mention. This work is rapidly becoming greater from year to year, not merely by reason of the increase in the population of the country but also because of the extension of the "registration areas" for births and deaths. The collection of birth statistics by the Census Bureau was begun only a few years ago, but already the birth-registration area comprises 13 States and the District of Columbia and contains considerably more than a third of the total population of the country. The death statistics, which 10 years ago related to less than one-half of the population of the United States, now pertain to approximately 70 per cent. As a result of the growth of this branch of the work, it has become necessary during a portion of each year to employ a number of temporary machine operators in the division of vital statistics. Some of these operators have been former employees of the Census Bureau, and the remainder have been obtained, so far as possible, from the registers of the Civil Service Commission.

A further need for the enlargement of the Bureau's force is found in the fact that during the coming fiscal year—whose termination marks the beginning of the Fourteenth Census period (July 1, 1919)—it will be absolutely necessary, if that census is to be taken properly, to do a great deal of preparatory work for it.

As pointed out at the beginning of this report, under the head "Organization and scope of work," the division of agriculture, which went temporarily out of existence at the close of the Thirteenth Census period, has recently been reestablished. The force of this division, however, at present comprises only one official and six employees. A great deal of work must be done in preparation for the Fourteenth Census, and all comparative tables (that is, tables presenting Fourteenth Census statistics side by side with corresponding figures for preceding censuses) to be printed in the reports should be prepared, so far as figures for the Thirteenth and preceding censuses are concerned, before the beginning of the Fourteenth Census period, or at least before the enumeration is made. This can not

be done, however, unless a very much larger force is provided for the division.

The work of preparing for the decennial census of mines, quarries, and oil and gas wells will also be considerable and should be commenced at the beginning of the next fiscal year.

The geographer's division, the duties of which will include the establishment of several hundred supervisors' districts and approximately 75,000 enumerators' districts, in preparation for the Fourteenth Census, must begin this work early in the coming fiscal year and will, therefore, need an increase in its force.

The divisions of population and manufactures will also need more clerks for preliminary Fourteenth Census work, although, by reason of the fact that these divisions have been in continuous existence since the Thirteenth Census, their needs in this respect will not be so great as those of the division of agriculture.

In making its estimates of appropriations for the coming fiscal year, therefore, the Census Bureau will ask for an increase of 79 in its statutory force; and in order to make its salary scale more nearly comparable with the salary scales prevailing elsewhere in the Government service, the majority of the increases requested are in the classes above \$1,200.

The present and proposed classifications are shown below.

Grade.	Office force, 1918.			Estimates, 1919.		
	Number.	Salary.	Amount.	Number.	Salary.	Amount.
Director.....	1	\$6,000	\$6,000	1	\$6,000	\$6,000
Chief statisticians.....	5	3,000	15,000	5	3,000	15,000
Statistical and technical expert.....	1			1	3,000	3,000
Chief clerk.....	1	2,500	2,500	1	2,500	2,500
Geographer.....	1	2,000	2,000	1	2,000	2,000
Stenographer.....	1	1,500	1,500	1	1,500	1,500
Expert chiefs of division.....	9	2,000	18,000	9	2,000	18,000
Clerks:						
Class 4.....	15	1,800	27,000	23	1,800	41,400
Class 3.....	25	1,600	40,000	35	1,600	56,000
Class 2.....	40	1,400	56,000	110	1,400	154,000
Class 1.....	288	1,200	339,600	250	1,200	300,000
\$1,000.....	83	1,000	83,000	83	1,000	83,000
\$900.....	81	900	72,900	91	900	81,900
Skilled laborers:						
\$900.....	2	900	1,800	3	900	2,700
\$720.....	1	720	720	1	720	720
Messengers.....	3	840	2,520	3	840	2,520
Assistant messengers.....	5	720	3,600	5	720	3,600
Unskilled laborers.....	4	720	2,880	4	720	2,880
Messenger boys.....	3	480	1,440	4	480	1,920
Total.....	563		676,460	642		789,300

Under the proposed classification, as set forth in the above table, 29.1 per cent of the Census Bureau's force will be paid salaries higher than \$1,200 per annum. Even this percentage, although considerably greater than the corresponding one for the present year (17.4), is still materially below that for the other branches of the departmental service, taken as a whole. (See subsection headed "Losses due to low salary scale.")

The increase requested is needed in part to provide for the growth in the Bureau's current work and in part to provide for the preliminary Fourteenth Census work. Even the entire amount of the

increase—\$112,900, as compared with the current appropriation for salaries—is very small, indeed, in comparison with the cost of taking a decennial census, and the authorization of its expenditure will make possible the saving of a much greater amount in the cost of the Fourteenth Census work and will result in expediting the publication of the Fourteenth Census reports.

The importance of making suitable provision for beginning preparatory work in time and for carrying it on with proper thoroughness and speed can not be too strongly emphasized. This matter is further discussed in the section entitled "Plans for future work."

#### PROMOTION OF MESSENGER BOYS.

The statutory roll of the Census Bureau for a number of years has provided three messenger-boy positions. Since December 1, 1915, five messenger boys have left to obtain elsewhere the increased pay which the Bureau was prevented from giving them by section 6 of civil-service Rule XI. This provision of the civil-service rules is as follows:

Messenger boys appointed without regard to the apportionment shall not be promoted or transferred to apportioned positions whether they are residents of States or Territories which are entitled to appointments to apportioned positions or not.

Of these five employees, three had served between three and four years; one, a little over one year; and one, about nine months. Some were boys of unusual intelligence and capability whose merits the Bureau would have been glad to reward if it had been possible to do so; but vacancies occurring in the grade of assistant messenger and messenger, unless filled by transfer, must, under the civil-service rules, be filled, through certification from the registers of the Civil Service Commission, by appointment of men who, as a rule, are not as efficient as the messenger boys whose promotions are precluded.

Under existing conditions, therefore, it is necessary for the Census Bureau to take boys from 16 to 18 years of age, to pay them \$480 per annum, to give them a certain training in its work, and then after a few years to lose them. In any business office an intelligent and industrious boy has an opportunity to advance, but, to a considerable extent, such opportunity is denied him in the Government service by the provision of the civil-service rules above quoted. This is unfair both to the boys themselves and to the offices in which they are employed.

#### SUPERANNUATION.

On July 19, 1917, I was asked to appear before the Senate Committee on Civil Service and Retrenchment, but as the House Committee on Appropriations requested my presence at the same time I was unable to do so. However, the chief clerk of the Bureau, whom I designated to represent me before the former committee, appeared and urged the enactment of an equitable system of retirement legislation, in which both male and female employees would participate on the same basis. He submitted the following table, relating to July 1, 1917, in which are shown the officials and employees of the Bureau, by age groups, for the information of the committee:

Grade.	Under 35.		35 to 50.		50 to 60.		60 to 65.		65 to 70.		70 and over.		Total.		Grand total.
	Men.	Women.	Men.	Women.	Men.	Women.	Men.	Women.	Men.	Women.	Men.	Women.	Men.	Women.	
Officials.....	...	...	7	...	5	...	3	...	...	...	1	...	16	...	16
Clerks, \$600-\$1,800, inclusive.....	84	24	95	144	53	70	15	6	10	2	11	...	268	246	514
Subclerical.....	7	...	5	...	2	...	...	...	...	...	2	...	16	...	16
Machine shop.....	3	...	10	...	...	...	...	...	...	...	1	...	14	...	14
Total.....	94	24	117	144	60	70	18	6	10	2	15	...	314	246	• 560

## SUMMARY.

Age.	Number.	Per cent of total force.	Age.	Number.	Per cent of total force.
Under 35.....	118	21	65-70.....	12	2
35-50.....	261	47	70 and over.....	15	3
50-60.....	130	23			
60-65.....	24	4	Total.....	• 560	100

\* On July 1, 1917, there were three vacancies in the statutory force of the Bureau.

There is no serious loss of efficiency in the Bureau at this time due to superannuation, since at present only 27 employees, or 5 per cent of the force, are over 65 years of age. This is because of the fact that when the Bureau was organized on a permanent basis in 1902 an age limit of 45 years was fixed for appointment, except in the cases of Civil War and Spanish War veterans. The situation has also been improved somewhat during the past two years by confining permanent appointments to persons not over 35 years of age.

It will be noted from the foregoing table, however, that 181 employees, or 32 per cent of the force, are over 50 years of age, so that continued failure to enact retirement legislation will result in the Census Bureau having within the next 10 or 15 years a large number of employees whose efficiency will be impaired because of advanced age. It is hoped that Congress will provide a retirement system before the Bureau's force reaches this condition.

## WORK DONE DURING FISCAL YEAR AND SINCE ITS CLOSE.

During the fiscal year the Bureau of the Census completed the compilation and publication of the primary or fundamental statistics derived from its latest canvass of manufacturing industries, carried on the compilation of more detailed statistics for later publication, and issued the Abstract of the Census of Manufactures and numerous final reports, in bulletin form, for separate States and for separate industries; conducted its regular annual inquiries relating to births, deaths, States, and municipalities; published a report on the blind and brought well toward completion the preparation of reports on the deaf, on Negroes, and on prisoners and juvenile delinquents; published special reports on mortality from cancer and on the cost of city cartage; made quarterly collections and publications of statistics relating to stocks of leaf tobacco; made monthly and semimonthly collections and publications of statistics relating to cotton and to cotton seed and its products;



performed considerable work for the Treasury and War Departments and the United States Shipping Board in connection with the preparations for war; complied with many requests for information contained in its records; and began work on its decennial canvasses of religious bodies and water transportation, its quinquennial canvass of electrical industries, and its special canvass of marriages and divorces.

Since the close of the fiscal year the Bureau has issued a considerable number of State and industry reports of the last census of manufactures, in bulletin form, and has carried on the compilation of others; and has been engaged in the compilation of the 1917 edition of the Official Register of the United States, in the conduct of the usual annual, quarterly, and monthly inquiries, and in preparatory work for the forthcoming census of electrical industries.

The work done along the various lines above specified is described in the sections headed "Current and completed work on statutory inquiries" and "Special and miscellaneous lines of work," which follow.

### CURRENT AND COMPLETED WORK ON STATUTORY INQUIRIES.

#### CENSUS OF MANUFACTURES.

The last quinquennial census of manufactures, which covered the calendar year 1914, was taken during the following year. In order to facilitate the work and permit the publication of the statistics at the earliest possible date, many changes and improvements were made in the methods employed, with the result that not only was the canvass brought to completion more expeditiously than at preceding censuses, but the primary or fundamental figures derived therefrom were made public, in the form of press summaries, more promptly than heretofore. The work of compiling and publishing these press summaries, or preliminary statements, began in June, 1915, and was completed in August, 1916. The summaries gave, for States and for cities having 10,000 or more inhabitants, statistics as to number of establishments; proprietors, officials, and employees; horsepower; capital; salaries and wages; cost of materials; value of products; and other items. They also gave similar statistics for 37 industries and special statistics as to materials and products for 63 industries. In all, 852 of these press summaries were issued for the 1914 census of manufactures. The summary giving the statistics relating to all manufacturing industries combined, for the entire United States, was sent to the printer on July 24, 1916—an earlier date, relatively to the period covered by the inquiry, than that on which the comparable figures for any preceding similar census had gone to press.

Tables were prepared and published in pamphlet form covering four census years and giving comparative statistics of manufactures for the United States by geographic divisions, States, and industries. There was so great a demand for these figures that statements for some of the principal industries were issued in multigraphed form in advance of the publication of the pamphlet.

The preliminary figures having thus been published, the clerical force of the Bureau was concentrated, so far as possible, upon the

preparation of the analytical tables and text for the final reports. These are being published first in bulletin form, a separate quarto bulletin being issued for each State and the District of Columbia and for 41 selected industries. These bulletins will later be bound together in three large quarto volumes. Of the 49 bulletins for the States and the District of Columbia, 33 have been published and the remaining 16 are in the hands of the printer; and of the 41 industry bulletins, 13 have been published, 24 are in proof, and copy for 3 more is now in the hands of the printer. In the case of the remaining industry, shipbuilding, the 1914 statistics will not be published separately but will be issued together with those for 1916, which are now being compiled in connection with the census of transportation by water. (See subsection headed "Census of shipbuilding.") The work of preparing the State bulletins for publication in the form of two bound volumes is now in progress, and analytical tables are being compiled for the report on industries, to be published in a similar volume.

The Abstract of the Census of Manufactures was completed and published during the fiscal year. This is an octavo volume of 722 pages presenting in condensed and convenient form the more important statistics derived from the census of 1914. It contains 223 tables with descriptive text giving brief comments on the statistics. This abstract is, in some respects, a new departure in census work and has proved to be a popular publication. It differs from the abstracts of the decennial censuses of 1890 and 1900 in that it contains analytical tables, comparative figures for earlier years, and text discussions; it differs from the abstract of the decennial census of 1910 in that it presents the statistics in considerably greater detail, and at the same time is of octavo instead of quarto size and, therefore, more convenient for handling; and it differs from all former abstracts in that it contains statistics of manufactures only. Since the abstract will supply the needs of a great majority of those using the statistics of manufactures, it was the first volume of the final reports to be issued. There has already been a great demand from manufacturers and others for this publication. It is not for free distribution, but may be purchased from the Superintendent of Documents, Government Printing Office, at 65 cents a copy.

#### TRANSPORTATION BY WATER: 1916.

The act creating the permanent Census Bureau authorized the Director of the Census to make an inquiry relating to water transportation at decennial intervals. The first inquiry conducted under this authority was made for 1906, and the current one relates to the calendar year 1916. The report will give detailed statistics as to number, tonnage, value, ownership, employees, wages, amount of business done, etc., for the various classes of craft.

At the request of the Secretary, all collectors of customs furnished the Bureau of the Census with lists of undocumented craft. Arrangements were made with the Postmaster General whereby postmasters in cities and towns situated on the coast and inland waters were permitted to assist the Bureau by the preparation of similar lists. A circular from the Postmaster General was prepared and

sent to approximately 7,000 postmasters, and reports were received from practically all of them. The Director of the Census and the chief statistician for manufactures attended a meeting of the American Steamship Association on July 18, 1916, and were successful in securing the cooperation of the association in taking this census. Arrangements were made with the Bureau of Foreign and Domestic Commerce under which the Bureau of the Census was permitted to compile, from the records of the former bureau, statistics in regard to shipments of freight from and to the principal ports on the Great Lakes. This made it unnecessary to call on shippers for census reports of the quantities of freight carried on the Great Lakes, which in a measure would have duplicated the manifests they were required to make to the Bureau of Foreign and Domestic Commerce.

By cooperation in these various ways it has been possible to facilitate greatly the work on this inquiry and to keep down its expense.

Index cards containing names and addresses of all vessels to be covered by the water-transportation census were prepared, and the schedules to be used were drafted and printed. Since at the census of 1906 it was found very difficult to obtain reports on the detailed schedule for some of the small craft, especially canal boats and other unrigged craft, and since it was the intention to collect reports by correspondence so far as possible, a card schedule was formulated for use in securing returns for the craft for which no book accounts were kept. In taking this census, therefore, four schedules have been used, as follows: For steam and other machinery-propelled vessels; for sail vessels; for unrigged craft; and the card schedule, used interchangeably for any class of craft. In the case of each owner or operator who reported at the census of 1906 a copy of his report for that year was made on the proper schedule and mailed to him with the request that he supply a similar report for the census of 1916.

The effort to collect a large proportion of the data by mail, and in some cases by telegraph, was successful, and over 70 per cent of the index cards were thus disposed of before the field force left the office. Although this method necessitated the preparation of a large number of blanks, including schedules, form letters, and post cards, and involved a great amount of correspondence, it materially reduced the expense of the field work and facilitated the completion of the census.

The field force was organized, and the entire country laid out in eight districts, as follows: Atlantic coast; Gulf of Mexico; Pacific coast; Mississippi River and its tributaries; Great Lakes; canals; inland waters other than canals; and Alaska, Porto Rico, and Hawaii. The field work, which was begun in March, is now practically completed.

The examination and editing of the schedules is progressing in a satisfactory manner, the tabulation has been begun, and it is hoped to make public the report at a relatively earlier date than that at which the report of the census of 1906 was published.

Statistics relating to the operations of fishing vessels, which were not covered by the inquiry of 1906, have been obtained at this census.

## CENSUS OF SHIPBUILDING: 1916.

A census of shipbuilding has also been taken in conjunction with the 1916 census of transportation by water. Form letters were prepared for use (a) in sending to each owner and operator a copy of the report made by him at the 1914 shipbuilding inquiry (taken as a part of the manufactures census of that year), with the request that he make a similar report for 1916, and (b) in collecting returns for shipyards that were not in existence in 1914; and letters were written to the governors of Hawaii, Porto Rico, and Alaska, asking for lists of shipyards in their respective Territories. This plan made it possible to obtain a large proportion of the reports by correspondence. Nearly all the establishments covered by the shipbuilding inquiry have already been accounted for, and the schedules received are now being edited, tabulated, and summarized.

A preliminary statement has been prepared giving, by coast districts and inland waters, separate statistics for steel and wooden vessels launched during the years 1916 and 1914, classified according to gross and net tonnage and character of power used; and a bulletin similar in form to those issued for the various industries covered by the last manufactures census is in process of preparation.

## ELECTRICAL INDUSTRIES: 1917.

The census of electrical industries covers central electric light and power stations, street and electric railways, telephones, telegraphs, and municipal electric fire-alarm and police-patrol signaling systems. This inquiry has been made at quinquennial intervals, beginning with that for the year 1902, under the authority of the act establishing the permanent Census Bureau, and the current one, therefore, relates to the calendar year 1917. The preparation of index cards containing names and locations of establishments is now in progress.

In revising the schedule for electric railways, various inquiries under "Financial statistics" have been changed or regrouped in order to conform to the latest system of accounting adopted by the Interstate Commerce Commission.

A representative of the American Telephone & Telegraph Co. visited the Bureau in August and took part in a conference held for the purpose of establishing the form of the telephone schedule. Through the cooperation of the Post Office Department, a circular letter will be addressed to approximately 25,000 postmasters throughout the United States, requesting the names and locations of farmer or rural telephone lines or systems. The information supplied by the postmasters will supplement that obtained from the schedules used at the 1912 inquiry.

It is the intention to collect the reports for the census of electrical industries, so far as possible, by correspondence. A copy of the returns made for the census of 1912 will be sent to each establishment covered by that inquiry, together with a blank schedule for 1917, with the request that a similar report be furnished for this census.

## VITAL STATISTICS.

The regular annual reports presenting statistics on mortality for the calendar years 1914 and 1915 were completed and published during the fiscal year 1917. The report giving birth statistics for the calendar year 1915 was issued early in August, 1917.

Reports giving mortality statistics and birth statistics for 1916 will be ready for the printer about December 1, 1917.

As set forth in my last report, a birth-registration area comprising the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Michigan, and Minnesota and the District of Columbia was established toward the close of the calendar year 1915. This area, although it represented barely 10 per cent of the territorial extent of continental United States, had an estimated population of about 32,000,000, or more than 31 per cent of the total for the country. Maryland, Kentucky, and Virginia have since been added. Tests of the completeness of birth registration are now in progress in New Jersey and Indiana, and on their completion other tests will be begun in North Carolina, Ohio, Utah, and Wisconsin. The results obtained so far indicate that the registration area for births will be materially increased during the present year. The statistics gathered thus relate to an area having a population of such size and heterogeneity as to render them of great value and significance.

The reports show, for the registration area and its subdivisions, number of births, by sex and month; number of births, by sex, color, and parent nativity of white children; number of births and deaths, with excess of births over deaths and number of births per 100 deaths; and number of births of white children, by country of birth of father and of mother. Birth and infant-mortality rates in foreign countries are also shown.

The registration of deaths—which, like birth registration, is necessarily, under the Constitution of the United States, a function of the State and municipal authorities—is constantly becoming more nearly complete, the registration area having been extended until it now comprises 26 States, 46 cities in other States, and the District of Columbia, and contains over 70 per cent of the total population of the country.

A reprint was made of the Physicians' Pocket Reference to the International List of Causes of Death during the fiscal year, and a copy was sent to every physician in the United States whose name appeared in the American Medical Directory for 1916.

Transcripts of birth and death statistics for 1917 are being received and edited.

The census reports presenting vital statistics maintain a high standard of usefulness, which will be raised still further by the extension of the scope of certain branches of the work as explained in the subsection relating to vital statistics in the section headed "Plans for future work."

## FINANCIAL STATISTICS OF CITIES: 1916.

The annual report presenting comparative financial statistics of cities having 30,000 inhabitants or more, relating, in the case of each

city, to its latest fiscal year terminating prior to July 1, 1916, was completed and sent to the printer in December, 1916, or within less than six months from the close of the fiscal period covered. This report covers (1) total and per capita receipts from the various sources of revenues; (2) total and per capita payments for expenses, interest, and outlays, the payments for expenses and outlays being given in detail; (3) total value of city properties; (4) total and per capita indebtedness; and (5) estimated true value and assessed valuation of taxable property, tax levies, rates, and methods of assessment. In addition, data on governmental organization were collected which show number, terms of office, methods of election or appointment, and annual salaries of specified city officials; form of government under which the city operates; if under commission form, departments over which each commissioner presides, and date when commission plan became operative; and a condensed history of the modern movement toward alteration of governmental organizations. Definitions of the terms employed in municipal accounting and a discussion of the difficulties encountered and methods employed in securing comparable data are given in the introduction.

All the field work on the current inquiry will be finished by the close of October, 1917, and copy for the report will be in the hands of the printer by the end of December.

The purpose of the reports on municipal finance, which have been published annually by the Bureau of the Census since 1902, is to present comparable statistics of cities for the information of city officials, civic bodies, students of economics interested in city management, and citizens who take an interest in questions relating to city betterment. To secure statistics that are comparable, the Bureau sends its agents to the various cities to translate into a standard classification the data contained in their accounts and reports, thus securing a uniformity of presentation that could not otherwise be obtained. The wide-awake citizen interested in the physical and financial welfare of his city desires to ascertain the weak points in its governmental methods by comparing its operations with those of other cities of similar size and situation. To provide the data to make this comparison possible is the purpose of the inquiry conducted by the Bureau of the Census. In so far as this purpose is accomplished, the city is assisted in securing better management and more economical administration of its public funds. Better management results in improved health conditions, greater recreational opportunities, and wider scope for educational activities; and more economical administration, whether securing better service for moneys expended or retaining in the city treasury for future use moneys formerly wasted, results in benefit to every taxpayer.

The classification of receipts and payments presented in the schedules of the Bureau of the Census has been indorsed by many of the leading civic organizations and has been adopted by a large number of cities and several States.

It is worthy of mention that the chief statistician in charge of the division of statistics of cities and 11 employees of that division have taken a special course in accounting which requires from 10 to 15 hours a week and about 51 weeks of actual study to complete.

## GENERAL STATISTICS OF CITIES: 1916.

The report on this inquiry, which also refers in the case of each municipality having 30,000 or more inhabitants to its latest fiscal period terminating prior to July 1, 1916, was completed in December, 1916, and relates to the general subject of recreation. The principal features of this report, which is much in demand, are statistics of parks, playgrounds, museums and art galleries, zoological collections, music and entertainment, swimming pools and bathing beaches, and other special facilities for recreation.

The report presenting general statistics of cities for 1917, now in process of compilation, will give detailed data on fire departments in all cities having estimated populations of 30,000 and over, covering organization, equipment, grades and salaries, special training of firemen, appointments, promotions, pension systems, and other items considered of interest and value by authorities on this subject, who were consulted before the schedule was drafted.

Another subject to be included in the general-statistics report for 1917 is that of specified sources of city revenues. Under this head will be included data in regard to certain methods of providing revenues, such as deriving them from business taxes collected without the issue of licenses—for example, on gross earnings of insurance companies; from special assessments for public improvements, as for street paving, sidewalks, and sewer construction, with the percentage of cost paid by the benefited property owners; and from other methods of assessments, as for street cleaning and sprinkling. There will also be shown the kinds of other business licenses, the amounts derived from them, the rates of license fees, and the periods for which the licenses are granted. This information has been requested by city officials for a number of years. The annual financial-statistics reports show the amounts collected from such sources, but not the methods of levying and collecting.

The field work on the current general-statistics inquiry will be finished by October 15, 1917, and the copy for the report will be in the hands of the printer by the end of December.

## FINANCIAL STATISTICS OF STATES: 1916.

The report giving comparative financial statistics for the 48 States and relating in each case to the latest fiscal year terminating prior to July 1, 1916, was completed in March, 1917, and sent to the printer shortly thereafter. The annual reports on this subject, of which the one referred to is the second, are similar in scope to those presenting financial statistics of cities. The general classifications are the same, changes having been made only when necessary in order to show data for the functions exercised by State governments that are not generally exercised by city governments. These statistics are in high favor with the State officials, and the annual visits of the agents of the Bureau to the several States for the purpose of collecting them will have great influence in bringing about the installation of proper accounting systems, as in the case of the cities having populations in excess of 30,000, for which similar statistics are published.

All the field work on the current State-finance investigation will be finished by the close of October, 1917, and copy for the report will probably be sent to the printer some time in February, 1918.

#### COTTON AND TOBACCO STATISTICS.

*Cotton and cotton seed.*—During the fiscal year the Census Bureau conducted its regular inquiries in regard to cotton and cotton seed. The reports issued comprised 10 relating to cotton ginned to specified dates during the ginning season; 12, published monthly during the year, relating to cotton consumed, imported, exported, and on hand, and to active consuming cotton spindles; 9, published at monthly intervals, relating to cotton seed received, crushed, and on hand, and to cottonseed products manufactured, shipped out, and on hand; 4, published quarterly, pertaining to bleached cotton fiber consumed in the manufacture of explosives; 2, published quarterly, relating to unbleached cotton fiber consumed in the manufacture of absorbent and medicated cotton; an annual bulletin on cotton production and distribution for the season of 1915-1916; and an annual pamphlet giving statistics on cotton production from the crop of 1916.

The periodical reports on cotton ginned, the monthly reports relating to cotton consumed, etc., and the monthly reports pertaining to cotton seed and cottonseed products are issued in the form of postal cards, which are mailed to a large number of growers, ginners, manufacturers, dealers, and others interested in the cotton and cottonseed industries. The annual bulletin presents, in amplified form, with text discussion, the statistical material contained in the postal-card reports for the year, together with other information not given in those reports.

The monthly reports on cotton seed and its products and the quarterly reports on cotton fiber consumed in the manufacture of explosives and of absorbent and medicated cotton mark the beginning of three new series of reports pertaining to the cotton and cottonseed industries, authorized by the act of August 7, 1916. Statistics relating to cottonseed products and linters obtained were published quarterly prior to the passage of this act under the general authority contained in the legislation authorizing the collection and publication of cotton statistics; but those now being issued at monthly intervals under authority of the act of August 7, 1916, cover the subject in much greater detail.

*Stocks of leaf tobacco held by manufacturers and dealers.*—During the fiscal year the Bureau issued, in the form of post cards, three quarterly reports relating to stocks of leaf tobacco, classified according to principal types, held by manufacturers and dealers. Under authority contained in the act of April 30, 1912, the Bureau had issued reports on this subject at semiannual intervals; but in compliance with the terms of the act of May 10, 1916, these reports have been published quarterly, beginning with that for October 1, 1916. At the close of each calendar year there will be issued a bulletin presenting the statistics contained in the several quarterly reports for the same year, together with data as to acreage, production, imports, exports, consumption, etc.



## REPORTS RELATING TO SPECIAL CLASSES OF THE POPULATION.

The work on these reports has been considerably delayed because of the inadequate size of the Census Bureau's force and the necessity for employing it on other work considered to be of more pressing importance. The fundamental or basic statistics, which are of most interest to the general public, have, however, been issued some time since in bulletin form. The final and detailed reports have been prepared with a great deal of care in the belief that their permanent value was so great as to justify the delay due to the taking of sufficient time to make a thorough and exhaustive analysis of the figures, especially in view of the fact that the primary or fundamental figures had already been published in bulletin form.

*The blind.*—The report on the blind, which was completed and published during the fiscal year, is probably the most comprehensive and thorough statistical treatment of the subject ever published in English. It has been very favorably received and highly commended by specialists and by persons engaged in philanthropic work on behalf of the blind. The letters acknowledging its receipt and the press notices indicate that the interest attaching to a report of this character is very considerably enhanced if in addition to elaborate statistical tables it comprises a careful study and interpretation of the data.

*Deaf-mutes.*—The preparation of the report on deaf-mutes was completed shortly after the close of the fiscal year, and it is now in the hands of the printer. This report also has been very favorably received and commended by specialists and others interested in the subject, to whom it was submitted in proof.

*Negroes.*—The report on Negroes, which is now in type and will soon be published, is a compilation of statistics covering the entire period from 1790 down to the present time, including data from the annual mortality reports from 1900 to 1915, as well as from reports of the decennial censuses. The report thus presents, so far as data are available, a complete statistical account of the Negro race in the United States. Not only is this special report of permanent statistical value in itself, but it contains a vast amount of material which will be useful and easily available for incorporation in the Fourteenth Census reports. To some extent, therefore, the work done in compiling this report is preparatory work for the Fourteenth Census.

*Prisoners and juvenile delinquents.*—This report also is now in type and will be issued in the near future. As in the cases of the other reports relating to special classes, it will present a thorough and exhaustive analysis of the statistics which it contains.

## RELIGIOUS BODIES.

The census of religious bodies is, under the law, taken at decennial intervals. The current inquiry relates to the calendar year 1916. The report, which will be published before the close of the present fiscal year, will present, for each religious denomination, detailed statistics in regard to church membership, church property, number and salaries of ministers, Sunday schools, etc.

Because of the pressure of other work, preparations for the 1916 census of religious bodies could not be begun until October of that year; and the progress of the work was interrupted somewhat during

the following May and June by reason of the necessity for employing considerable numbers of clerks on special work for the Treasury and War Departments.

Conferences were held with representatives of religious organizations, at which suggestions were made which have aided greatly in determining the extent and form of the inquiries to be made on the schedules. Notices regarding the census of religious bodies were sent during the year to the religious press generally. These notices were cordially received, and in several instances translations were made for insertion in papers other than English.

This census will cover about 204 denominations, comprising 240,000 churches. The statistics for 124 of these denominations are to be secured wholly by mail, for 9 denominations partly by mail and partly by contract, and for the remaining 71 denominations wholly by contract. The first church schedules were mailed on January 4, 1917. At the close of the fiscal year schedules had been sent to 213,379 churches, and the total number returned was 128,991, or about 60 per cent of the number sent; and to date (Sept. 30) a total of 232,288 schedules have been sent out, of which 167,186, or 72 per cent, have been returned.

#### OFFICIAL REGISTER.

The Official Register of the United States is now in course of preparation. This publication consists mainly of a directory of Federal employees, showing name, designation, compensation, branch of service in which employed, etc. (See reference to Official Register in section headed "Legislation needed.")

#### SPECIAL AND MISCELLANEOUS LINES OF WORK.

##### MARRIAGE AND DIVORCE.

Statistics of marriage and divorce covering the calendar year 1916 are now being collected. The canvass thus far has been conducted entirely by mail.

Statistics pertaining to the subject of marriage and divorce for the 40-year period 1867 to 1906, inclusive, have heretofore been collected and published, and it had been the intention to compile such statistics for the 10-year period 1907-1916; but because of the national crisis, as a result of which the Census Bureau has been called upon to do considerable emergency work for other departments whose activities are intimately connected with war preparations, it has been decided to make the current inquiry relating to marriage and divorce cover only the year 1916.

The report will show, among other things, by counties, the number of marriages performed and the number of divorces granted during the year 1916, with detailed statistics for divorces, covering such matters as duration of marriage; cause of divorce; party to which granted, and whether contested; number of children; and whether alimony was asked, and whether granted.

##### MONOGRAPH ON CANCER.

A monograph entitled "Mortality from Cancer and Other Malignant Tumors in the Registration Area of the United States, 1914," was completed and published during the past fiscal year. This mono-

graph presents, in much greater detail than that given in the annual reports issued by the Bureau, statistics relating to deaths from cancers and other malignant tumors throughout the registration area in 1914. The work was undertaken at the request of the American Society for the Control of Cancer. Both this society and the American Public Health Association are especially interested in the monograph and have been active in cooperating with the Census Bureau in its compilation.

#### SUPPLEMENTARY OCCUPATION STATISTICS.

At times when clerks could be spared from other and more pressing lines of work the tabulation of occupation statistics supplementary to those published as a part of the reports of the Thirteenth Census has been carried on. All information of this character has considerable permanent value in itself, but the main reason for compiling it is found in its great value as affording a proper measure of comparison with the occupational data to be secured in 1920. This is particularly important in view of the fact that the classification now employed was not in use prior to 1910.

A tabulation showing the marital condition of women gainfully occupied was prepared at the request of the American Labor Association for use in relation to the subject of health insurance, and particularly maternity insurance. The work was completed in March, 1917, and the results were transmitted to the secretary of the above-named association for its information and for use in States where legislative action in respect to health insurance had been taken or was then pending; and a press summary and mimeograph copies of tables were made available for the use of the press.

Other phases of the work on supplementary occupation statistics relate to occupations of the foreign born and of women and children.

#### CENSUS OF CITY DISTRIBUTION.

In view of the great importance of city cartage as an element in the total cost of goods to the consumer, the Bureau of the Census, in the latter part of the calendar year 1916, at the direction of the Secretary of Commerce, made a brief preliminary survey in the city of Washington covering four important classes of commodities—coal and wood, milk, ice, and department-store merchandise. The results of this survey, which were published in the form of a preliminary statement dated January 3, 1917, were considered by the Secretary to be sufficiently striking to justify him in directing the Census Bureau to make a further and more exhaustive inquiry. Unfortunately, the Bureau had not available either the force or the funds with which to extend the investigation to cities other than Washington; but an inquiry was made covering gross sales and delivery costs during the year 1916 in 120 carefully selected establishments in this city, representing 17 lines of retail business (some of which did a wholesale business also), together with 8 wholesalers of meat products, the report of which was published on April 21, 1917. On the basis of the results obtained from this canvass, the total transportation and cartage costs applying to commodities for public consumption in Washington were estimated, for the year 1916, at \$15,550,000 (of which amount slightly more than one-half represented cartage costs alone),

this being equivalent to approximately \$40 for each person, or \$190 for each family.

These figures emphasize the importance of the subject; and it is hoped that at some future time the Bureau will be in a position to make a more exhaustive canvass, covering a number of representative cities throughout the country.

#### FISHERIES OF NEW YORK CITY.

On August 23, 1917, the Secretary of Commerce authorized the Director of the Census to make a tentative collection of data pertaining to the fisheries of New York City during the period from September 1 to December 31, 1917, the details of the method to be employed in doing this work to be arranged by the Director of the Census and the Acting Commissioner of Fisheries. It is thought that by the close of the period specified it will be possible to determine the feasibility of making the inquiry a permanent one.

Since the conditions in New York City differ radically from those at other ports at which fishery agents are stationed, it will be necessary to develop a special scheme for collecting and reporting the data. The Director of the Census and the Acting Commissioner of Fisheries accordingly agreed that it would be advisable to have a field agent of the Bureau of Fisheries, who was acquainted with the New York fish trade, assist in the work for the first two or three weeks. An employee of the Census Bureau was designated to make the inquiry and entered on duty September 1, 1917.

The data to be collected comprise (1) landings of fresh fish by American fishing vessels and boats and (2) receipts of fresh fish by rail and steamer. The daily receipts will be published in monthly bulletins similar to those issued by the Bureau of Fisheries for the ports of Portland, Me.; Gloucester and Boston, Mass.; and Seattle, Wash.

#### EDIBLE VEGETABLE OILS.

The manufacture of edible oils from seeds other than cotton seed is of recent origin in the United States, only a few concerns engaged in the production of such oils having been reported at the manufactures census of 1914. Because of the rapidly increasing importance of this industry, the Bureau of Chemistry, of the Department of Agriculture, requested the Census Bureau to make a special canvass of it for the calendar year 1916. This was done, and the results were published in June, 1917, in the form of a press statement in which it was shown that 112 establishments produced during 1916 a total of 262,558,661 pounds of oils from peanuts, mustard seed, kapok seed, rape seed, sunflower seed, soy beans, walnuts, corn, copra, palm kernels, and olives. The movement to grow soy beans, peanuts, and other oil-bearing seeds and nuts for the production of oil has received a great impetus, and it is believed that several hundred establishments will be engaged in crushing the crops grown in 1917.

#### SPECIAL CENSUS OF POPULATION.

A special census of Shreveport, La., was taken as of February 15, 1917, at local request and expense.

## BULLETIN ON EXECUTIVE CIVIL SERVICE.

The Bureau is preparing a statistical report on the employees in the Federal executive civil service on July 1, 1916. Similar reports were published relating to the years 1903 and 1907. Individual cards to the number of about 250,000 have been filled out and returned by the different departments and offices of the Government and are now being edited preparatory to tabulation. This work is being carried on in cooperation with the Bureau of Efficiency, which is utilizing the data as a basis for computing the cost of civil-service pensions.

## LIFE TABLES.

As shown by my last report, the Census Bureau compiled a series of "life tables" based on the population in 1910 and the mortality in the three years 1909, 1910, and 1911, for the six New England States, New York, New Jersey, Indiana, Michigan, and the District of Columbia. These tables, which were published in June, 1916, are similar to those prepared by life insurance companies but differ from the latter in that they relate to the entire population of the area covered instead of being limited to risks selected through medical examination and otherwise. A similar set of tables exhibiting mortality conditions in 1890 and 1901 and during the decennium 1901 to 1910, inclusive, is now in course of preparation, and in the report presenting these tables will be given the original data on which they are based, together with an explanation of the methods employed in computing them.

A reprint of the tables already published was made from the original plates during the fiscal year 1917.

## STATISTICAL DIRECTORY OF STATE INSTITUTIONS.

As explained in my previous report, the Bureau has been compiling data for a statistical directory of State institutions for defective, dependent, and delinquent classes, which will show for each institution of that character the number of inmates; cost of maintenance; value of plant; acreage of grounds or land; numbers of officials, assistants, and employees; and other data. The returns are now nearly complete, only a few institutions remaining for which the schedules have not yet been received. The classes of institutions covered by this inquiry include State prisons and penitentiaries and State institutions for the insane, feeble-minded, epileptic, tuberculous, blind, deaf, and dependent. In addition to the data for the individual institutions the report will present general statistics for the States and summaries with maps indicating the location of the institutions, the density of population, etc.

## HISTORY AND GROWTH OF THE UNITED STATES CENSUS.

A volume having this title, published in 1900, gave a historical review of American census taking, showing the items of information called for by each of the schedules from census to census, publications, cost of censuses, summary of census legislation, etc. The material necessary for bringing up to date the information contained

in this volume is now being compiled, and there have been assembled nearly all the forms required to make a complete chronological presentation of the various census inquiries, showing the changes and developments which have taken place. This publication will be in the form of an additional volume compiled along the same lines as the original.

#### SEARCHING OF CENSUS RECORDS TO DETERMINE AGES.

The work of searching the census records to determine ages of individuals was considerably increased as a result of the registration, under the selective draft act, of men 21 to 30 years of age, inclusive. In order to establish the ages of men who failed to register, but were believed to be within the specified age limits, recourse to the enumerators' returns was necessary in many cases. The returns made at the census of 1900 were especially valuable for this purpose, since, in addition to the age at the last birthday, they also showed the month and year of birth.

#### THE CENSUS EXHIBIT.

The Census Bureau's exhibit at the Panama-Pacific International Exposition, which was awarded the grand prize and gold medal "For an exhibit of methods and machines employed in the collection and tabulation of statistics," was returned to the Bureau at the close of the exposition and has been made a permanent exhibit. It comprises an automatic tabulating machine, a sorting machine, a punching machine, and a large number of charts and maps, the latter showing graphically some of the results of the Thirteenth Census and of important inquiries that have been made since that census.

The establishment of this exhibit as a permanent one has been amply justified by the numerous requests for its display at expositions and by the interest in census work which it has aroused. It was shown at the meeting of the Western Pennsylvania Exhibition Society held at Pittsburgh during the month of September, 1916; at the Electrical Exposition and Motor Show in New York City from October 6 to 21, 1916; and at the Industrial Exposition and Export Conference held at Springfield, Mass., from June 23 to 30, 1917. A portion of the exhibit was also on display at the Annual Convention of the Chamber of Commerce of the United States held at the New Willard Hotel, Washington, D. C., January 31 to February 3, 1917. At each of these expositions publications of the Census Bureau were distributed by the persons in charge of the exhibit.

When not in use elsewhere this exhibit is installed in the Commerce Building and is always open to the public.

#### ASSISTANCE RENDERED OTHER DEPARTMENTS.

*Estimates of population for use of War Department.*—An important piece of work begun by the Census Bureau just before the close of the fiscal year and completed shortly afterward was the preparation of estimates of population for use in connection with the registration of men subject to military duty and with the apportionment of the draft. The first set of these estimates was prepared in May for use in appor-

tioning supplies of registration cards to the various counties and cities; and the second set, prepared late in June, was based on the registration and was intended solely for use in the apportionment of the draft among the States and their subdivisions. Both sets were prepared at the request of the Provost Marshal General of the War Department.

In making the latter estimates, the Census Bureau was confronted by the necessity of securing the greatest possible measure of justice to each community. The method adopted, therefore, was based on the assumption that the registrants in each community represented a fixed proportion of the population. This proportion for the United States as a whole was determined to be equal to 9.32 per cent; and the population estimates for the various States, cities, and counties were therefore computed by dividing the number of registrants by 0.0932. This method yielded the fairest possible basis for the apportionment of the draft, since the localities whose population was overestimated were those in which there was an excess of men 21 to 30 years of age, inclusive, while the localities whose populations were underestimated were those in which the proportions of men of these ages were smaller than the average.

Any other method which might have been employed would inevitably have resulted in overstating the population of some communities which had relatively small proportions of men 21 to 30 years of age; and the seriousness of the injustice that would thus have been brought about may be realized when the fact is taken into consideration that the proportion which men of these ages represent of the total population is fully three times as great in some localities as in others.

*Allocating enlistments and other work for the office of the Provost Marshal General of the War Department.*—Considerable work was done for the office of the Provost Marshal General of the War Department in connection with the allocation of enlistments in the Regular Army from April 2 to June 30, 1917, inclusive. The 117,974 men enlisting in the Regular Army during this period represented a portion of the credits to be applied to the gross quotas of the States and their 3,300 subdivisions in the apportionment under the selective draft act.

Other work done for the Provost Marshal General's Office included the addressing of franks and envelopes for use in the transmission of registration cards and instructions to governors, mayors, and sheriffs throughout the United States and the computation of the net quotas of the several States and Territories and the District of Columbia in the apportionment of the 687,000 men drafted on the first call.

*Liberty Loan work.*—A considerable number of clerks were employed for about a week in addressing envelopes and mailing copies of the Des Moines speech of the Secretary of the Treasury in regard to the Liberty Loan. This work was greatly appreciated by the Secretary of the Treasury.

*List of shipbuilding establishments.*—Special information was compiled from the 1916 shipbuilding inquiry for the use of the United States Shipping Board, and similar information, together with summaries of wage earners employed in shipbuilding establishments, has been furnished the Department of Labor.

*Total amount of war work done.*—The total time spent by the Census Bureau's force on war work, or work having some bearing on war

preparations—including, in addition to that already specified, work for the American National Red Cross, the Department of Justice, and the Council of National Defense and miscellaneous work for other governmental establishments or for individuals—to September 30, 1917, was equivalent to 4,550 days, or nearly 15 years, for one employee.

*Assistance to Federal Trade Commission in compilation of coal data.*—During the months of August and September, 1917, considerable assistance was rendered to the Federal Trade Commission in connection with the compilation of data relating to cost of production of coal at the mines and to prices at which coal has been sold at retail.

*Ages of pensioners.*—The value of the old decennial census records has been effectively demonstrated during recent years by the increasing number of requests from the Pension Bureau for data needed to establish the ages of pensioners, approximately 3,500 such requests having been received during the fiscal year 1917. Since, in order to obtain increases of pensions, soldiers and their widows are obliged to show evidence of their ages, and since throughout the greater part of the country no reliable birth records are in existence, or at least none have been maintained until recently, it has been necessary in many cases to obtain such evidence from Census records.

#### WORK IN MECHANICAL LABORATORY.

During the year the mechanical laboratory maintained the machines used in the Census Bureau and the Bureau of Immigration, made repairs to computing machines, rearranged the keyboards of 10 pantograph punches to conform to the requirements of the card used by the Eight-Hour Commission in tabulating its statistics, and made definite and satisfactory progress on the construction of the tabulating machines to be used in the Fourteenth Census. A new automatic tabulating machine was completed toward the close of the fiscal year, given a practical test in connection with the work of tabulating the mortality data of the division of vital statistics, and found to be entirely satisfactory and a great improvement over the machine used in the Thirteenth Census. This machine is to be used as a model in constructing 25 tabulating machines for the Fourteenth Census work. Many of the parts for these machines have already been manufactured in the mechanical laboratory or purchased in the open market upon specifications prepared by the Bureau's chief mechanician.

Considerable experimental work has been done on one of the sorting machines during the last six months with a view to bringing it to a higher state of perfection. One of the automatic punches used in the Thirteenth Census was rebuilt during the year and will be tested against an improved commercial key punch in order to determine which machine is better adapted to the punching work of the next decennial census.

If the Bureau obtains the necessary appropriations for the next fiscal year, it is planned to have the 25 tabulating machines, 5 extra tabulator bases, and 114 extra counting units of 10 counters each constructed and 19 card-sorting machines and 5 card-counting machines given a thorough overhauling, by July 1, 1919, the beginning of the Fourteenth Census period.



## INTEGRATING COUNTER.

For some years past the officials of the Census Bureau have had in mind the development of an "integrating counter"—that is, a counter which will not merely record and add units but will also record and add numbers, thus performing automatically the work done by the operator of an adding machine—for use in tabulating various classes of the data gathered by the Census Bureau, such as those pertaining to agriculture and manufactures. The need of an integrating tabulator for doing cost accounting and similar work in other governmental offices has also been recognized. In 1911 some sketches and drawings for a model integrator were made, but work along this line soon had to be discontinued in order that the entire energies of the mechanical-laboratory force might be directed toward the development of a sheet-printing device for use in connection with the automatic tabulator employed by the Bureau, and until very recently nothing further has been done in regard to the integrating counter.

Several types of integrating machines are now manufactured by private companies, but their use by the Bureau is undesirable not only by reason of their cost but also because the control of the tabulating devices used by the Government should not be in the hands of one company.

At the request of the Secretary of Commerce, Congress granted to the Census Bureau, in the legislative, executive, and judicial appropriation act for the fiscal year 1918, \$60,000 for expenditure in the development, improvement, and construction of tabulating machines, and \$30,000 of this amount has been allotted for use in the development and construction of an integrating counter. A force has been organized for the work, the patent situation has been carefully examined, machinery and supplies are being purchased, and other preliminary work has been begun.

## PUBLICATIONS ISSUED.

Following is a list showing the publications issued during the fiscal year and since its close. In addition to these, the Bureau has published a large number of press summaries.

Class and title.	Date issued.	Pages.	Edition.
JULY 1 1916, TO JUNE 30, 1917			
Reports (cloth bound and of quarto size except as otherwise indicated):			
Mortality statistics: 1914.....	Sept. 25, 1916	714	6,000
Mortality statistics: 1915.....	Apr. 27, 1917	707	5,000
Mortality from cancer and other malignant tumors in the registration area of the United States: 1914.....	Jan. 23, 1917	212	2,000
The blind in the United States: 1910.....	Apr. 10, 1917	342	4,000
Financial statistics of cities: 1915.....	Aug. 7, 1916	338	7,500
Financial statistics of States: 1915.....	Sept. 5, 1916	125	5,000
Plantation farming in the United States (paper).....	Jan. 25, 1917	40	2,000
Abstract of the census of manufactures: 1914 (octavo).....	June 22, 1917	722	10,000
Total.....		2,200	42,500

Class and title.	Date issued.	Pages.	Edition.
<b>Bulletins (quarto):</b>			
No. 122—Abstract, financial statistics of cities: 1915.....	Sept. 22, 1916	117	3,000
No. 123—Estimates of population, 1910-1916, including results of State enumerations made in 1915.....	Dec. 20, 1916	46	7,000
No. 124—Cotton production and distribution, season of 1915-16.....	Dec. 23, 1916	99	45,000
<b>Total.....</b>		<b>262</b>	<b>55,000</b>
<b>Census of manufactures: 1914—</b>			
<b>State bulletins—</b>			
Arkansas.....	June 8, 1917	23	1,200
Georgia.....	May 7, 1917	27	1,800
Idaho.....	June 2, 1917	15	900
Indiana.....	June 8, 1917	47	2,600
Louisiana.....	June 22, 1917	27	1,300
Mississippi.....	May 24, 1917	19	1,200
Nevada.....	Apr. 21, 1917	13	800
North Carolina.....	Feb. 28, 1917	25	2,600
Oregon.....	May 8, 1917	25	1,200
Rhode Island.....	June 8, 1917	31	1,100
South Dakota.....	May 7, 1917	15	1,000
Utah.....	May 8, 1917	21	800
Vermont.....	June 26, 1917	25	1,500
West Virginia.....	Mar. 24, 1917	25	1,900
Wyoming.....	Apr. 24, 1917	13	600
<b>Total.....</b>		<b>351</b>	<b>20,600</b>
<b>Industry bulletins—</b>			
Flour-mill and gristmill products.....	June 26, 1917	20	6,400
Glass.....	June 4, 1917	13	1,500
Ice.....	Mar. 24, 1917	15	5,600
Paper and wood pulp.....	June 8, 1917	19	2,500
Power laundries.....	July 31, 1916	23	8,500
Rice cleaning and polishing.....	Sept. 23, 1916	9	8,000
<b>Total.....</b>		<b>104</b>	<b>32,500</b>
<b>Report of special census (octavo): Population of Shreveport, La. (enumerated Feb. 15, 1917).....</b>	Apr. 17, 1917	8	300
<b>Miscellaneous publications:</b>			
Census of manufactures: 1914—General totals for the United States, by geographic divisions, States, and Territories, 1914, 1909, 1904, and 1899 (octavo).....	Dec. 13, 1916	26	10,000
Circular No. 2—Circular of information concerning Census publications: 1790-1916 (octavo).....	Feb. 9, 1917	124	2,000
Circular No. 5—Tentative program of the Bureau of the Census: 1916-1919 (octavo).....	Aug. 14, 1916	14	5,000
Annual report of the Director of the Census to the Secretary of Commerce, fiscal year 1916 (octavo).....	Nov. 10, 1916	31	2,500
Study of cartage costs in the city of Washington (octavo).....	Apr. 28, 1917	14	2,000
Manual of the international list of causes of death (second reprint; revised) (octavo).....	July 25, 1916	307	500
The story of the Census: 1790-1916 (reprint; revised) (octavo).....	Dec. 7, 1916	38	5,000
Advance tables of cotton production in the United States—crop of 1916 (quarto).....	June 26, 1917	43	41,000
Physicians' pocket reference to the international list of causes of death (2½ by 6 inches).....	Sept. 19, 1916	28	200,000
32 reports, in card form, relating to cotton and cotton seed.....	July 14, 1916 June 22, 1917	32	1,280,000
3 reports, in card form, relating to stocks of leaf tobacco.....	Nov. 8, 1916 Jan. 31, 1917 May 2, 1917	3	61,000
<b>Total.....</b>		<b>660</b>	<b>1,600,000</b>
<b>Grand total, July 1, 1916, to June 30, 1917.....</b>		<b>4,585</b>	<b>1,759,900</b>
<b>JULY 1 TO SEPTEMBER 30, 1917.</b>			
<b>Reports (cloth bound and of quarto size except as otherwise indicated):</b>			
General statistics of cities: 1916.....	Aug. 18, 1917	88	4,500
Financial statistics of cities: 1916.....	Sept. 22, 1917	375	6,500
Financial statistics of States: 1916.....	Sept. 4, 1917	127	3,500
Birth statistics for the registration area of the United States: 1915 (paper).....	Aug. 7, 1917	78	5,000
<b>Total.....</b>		<b>668</b>	<b>19,500</b>

Class and title.	Date issued.	Pages.	Edition.
<b>Census of manufactures, 1914:</b>			
<b>State bulletins—</b>			
Alabama.....	Sept. 22, 1917	29	1,300
California.....	July 25, 1917	63	2,000
Connecticut.....	Aug. 23, 1917	45	1,700
Delaware.....	Sept. 11, 1917	19	700
District of Columbia.....	Aug. 16, 1917	13	600
Florida.....	July 23, 1917	21	1,000
Kentucky.....	Aug. 29, 1917	27	1,200
Maine.....	Aug. 20, 1917	29	1,300
Minnesota.....	July 25, 1917	41	2,200
Missouri.....	Aug. 22, 1917	43	2,000
Montana.....	July 23, 1917	17	1,000
Nebraska.....	July 23, 1917	23	1,500
New Hampshire.....	Aug. 23, 1917	27	1,000
New Mexico.....	July 23, 1917	11	800
North Dakota.....	Aug. 28, 1917	15	1,000
South Carolina.....	July 23, 1917	21	1,100
Tennessee.....	July 23, 1917	31	1,500
Texas.....	Sept. 25, 1917	35	2,500
Virginia.....	Aug. 23, 1917	33	1,000
Washington.....	July 11, 1917	33	1,000
Wisconsin.....	Sept. 5, 1917	39	2,000
<b>Total.....</b>		<b>615</b>	<b>31,200</b>
<b>Industry bulletins—</b>			
Automobiles.....	Aug. 15, 1917	19	2,500
Butter, cheese, and condensed milk.....	Aug. 31, 1917	23	5,250
Glucose and starch.....	Aug. 20, 1917	9	1,300
Oilcloth and linoleum.....	Aug. 20, 1917	8	1,000
Soap.....	July 11, 1917	11	1,000
Sugar.....	July 2, 1917	13	1,200
Turpentine and rosin.....	July 11, 1917	10	1,300
<b>Total.....</b>		<b>93</b>	<b>14,250</b>
<b>Miscellaneous publication: Legislation relating to the Bureau of the Census.....</b>			
	Aug. 29, 1917	71	100
<b>Grand total, July 1 to September 30, 1917.....</b>		<b>1,447</b>	<b>65,050</b>

### PLANS FOR FUTURE WORK.

#### PREPARATIONS FOR FOURTEENTH CENSUS.

Perhaps the most serious obstacle in the way of the prompt and efficient handling of decennial censuses heretofore has been the lack of time given to the preliminary work previous to the actual enumeration. The Bureau of the Census was made a permanent organization at the close of the Twelfth Census period (July 1, 1902), primarily for the purpose of facilitating the work of future decennial censuses. If the Bureau is to succeed in any reasonable measure in justifying its permanent establishment—at least so far as this primary purpose is concerned—it must have, some time prior to the beginning of each decennial census period, a well-organized administrative and clerical force to serve as a nucleus for the enormously expanded organization necessary for the conduct of the decennial census work.

Furthermore, in order that preparations for the decennial census may be made intelligently and without waste of effort, it is necessary for the Bureau to know long in advance of the actual enumeration the exact nature and extent of the information it is to be required to secure, compile, and publish. In this connection Director North, in his annual report to the Secretary of Commerce and Labor, under date of December 1, 1907, said concerning legislation for the Thirteenth Census:

The Director of the Census is entitled to at least two years in which to prepare for the greatest single piece of work which the Government undertakes, and in order to make this preparation intelligently and to the best possible advantage he should know for that length of time just what are the provisions in the law under which the work is to be undertaken.

The Fourteenth Census period will begin July 1, 1919, and will end on June 30, 1922. Realizing the importance of making proper preparations for the taking of the Fourteenth Census, the Director of the Census, on March 20, 1917, issued an order to the officials of the Bureau in which attention was called to this matter and it was directed that current inquiries of the Bureau should be finished, so far as possible, and all the preliminary work for the next decennial census practically completed by the beginning of the census period.

In compliance with this order preparations for the Fourteenth Census have already been begun. These preparations include a consideration of the act providing for the Thirteenth and subsequent decennial censuses, with a view to determining whether amendments are required to adapt it to the needs of the Fourteenth Census and, if so, the character of such amendments; revisions of the schedules to be used in the several field canvasses; and work in the mechanical laboratory.

At about the close of the fiscal year a committee composed of officers of the Bureau was organized to consider what changes, if any, were necessary in the existing legislation. This committee has since been holding weekly meetings and will continue to do so until it has given thorough consideration to every section of the act providing for the Thirteenth and subsequent decennial censuses, after which it will formulate its recommendations in time for presentation at the opening of the next session of Congress.

In making its plans for taking the Fourteenth Census the Bureau has invited and obtained the cooperation of outside statisticians and others interested in census work. During the week beginning August 20, 1917, a series of conferences were held between representatives of the Census Bureau and a committee of statisticians of the Department of Agriculture in regard to changes in the schedules used in collecting agricultural data. The representatives of the Census Bureau, eight in number, had been temporarily appointed as special agents for service in connection with the revision of the agricultural schedules. Of these eight special agents, four had been officials of the division of agriculture, three had been special agents employed for expert work in that division during the Thirteenth Decennial Census period, and one was the editor of an agricultural periodical in North Carolina. The committee of the Department of Agriculture comprised five officials representing the Bureau of Crop Estimates, the Office of Markets, the Office of Farm Management, the Office of Farm Horticultural Investigations, and the Division of Animal Husbandry.

At these conferences a most gratifying spirit of cooperation—much greater than had prevailed in connection with the preparations for preceding censuses—was manifest, and the various recommendations as to changes in the agricultural schedules were agreed upon by unanimous vote. Some of the changes contemplated will have to receive the approval of Congress before they can be embodied in the schedules to be used at the Fourteenth Census, and recommendations as to the desired legislative action will be included in the report of the com-

mittee already referred to which is considering proposed changes in legislation.

The Department of Agriculture is planning to assist the Census Bureau by making a test of the tentative general schedule agreed upon. Through its field employees, a canvass of representative farms throughout the country will be made, the results of which will be tabulated by the Bureau of the Census. In this way the practicability of each of the various items of information called for by the schedule can be determined, and changes can be made if necessary in order to adapt it properly to the requirements of the Fourteenth Census work.

In making its preparations for the Fourteenth Census inquiries in regard to population, manufactures, and mines and quarries, as well as agriculture, the Bureau, having in mind the increase in the complexity of the inquiries that has taken place from census to census, with the result that it has become impossible to complete the work within the three-year period beginning on July 1 of the year preceding that in which the enumeration is made, is fully alive to the necessity for simplifying them to the greatest practicable degree and for rearranging its work so as to make possible the completion of the tabulations and the publication of the main reports of the Fourteenth Census by June 30, 1922, as prescribed by law. But if the Bureau is to be successful in carrying out its intentions in this respect, it will be absolutely necessary that the needed legislation be enacted in the near future and that—as pointed out in the section entitled “Office force”—an adequate amount be appropriated for preliminary work.

#### VITAL STATISTICS.

*Weekly mortality reports.*—Plans are now being made to issue weekly reports of mortality, which will give within 72 hours after the close of each week the mortality rates for about 50 large cities in the United States. Such reports will quickly reveal any unusual health conditions in any of our large cities and will serve as an important health index.

*Mortality from tuberculosis.*—A monograph on mortality from tuberculosis in the registration area for the calendar year 1918 will be prepared and published. It was originally intended to issue this monograph for the year 1916, but the work was postponed in the hope of obtaining more definite statements regarding the occupations of decedents. In view of the great mortality resulting annually from tuberculosis—which until recently exacted a heavier toll than any other cause of death and still leads all others except diseases of the heart (including endocarditis)—a publication of this character, showing the relationship between certain occupations and the prevalence of tuberculosis, will be of unusual value and interest.

*Color and race in relation to births and mortality.*—A monograph on mortality by color and race, with especial reference to birth-places of mothers of white persons, will be prepared and published. This monograph will measure the influence of color and race upon mortality rates, as revealed by the population and mortality figures for the calendar years 1910 and 1920.

As the birth-registration area grows and the birth statistics published by the Census Bureau assume a greater national significance.

the annual birth-statistics reports will be enlarged and tables will be added to show the influence of race and color upon birth rates and upon rates of infant mortality.

### LEGISLATION NEEDED.

#### FOURTEENTH CENSUS LEGISLATION.

As pointed out in the subsection headed "Preparations for Fourteenth Census," in the section entitled "Plans for future work," a committee appointed for the purpose is at present engaged in making a careful study of the act providing for the Thirteenth and subsequent decennial censuses, with a view to determining whether amendments are needed to adapt it to the requirements of the Fourteenth Census and, if so, the character of such amendments. Not all the committee's recommendations have yet been formulated, but they will be ready in ample time for submission to Congress in December.

#### REGISTRATION OF BIRTHS AND DEATHS.

In the matter of birth and death registration the United States has lagged far behind many other countries. This is because the registration of vital data has been left to the action of the individual States, many of which have failed to establish and maintain adequate systems of recording births and deaths.

The practice of the Census Bureau is to admit to the "birth-registration area" those States, and to the "death-registration area" those States and those cities in nonregistration States, in which, as the result of tests conducted by the Bureau, it appears that the registration is at least 90 per cent complete and in which the registration laws are such as to give promise of a still more nearly complete registration. In only 13 States and the District of Columbia does the registration of births comply with these requirements. In six more States tests are being made, or soon will be made, and the records of some of these States are likely also to be accepted in the near future. But throughout a large part of the country either there is practically no birth registration at all or the registration is far from complete.

The timeliness of this subject is obvious in view of the registration, on June 5, 1917, of all men between the ages of 21 and 30, inclusive, in compliance with the terms of the selective draft act. In many cases when it became necessary to establish the ages of men in order to determine their liability to draft no records except the census population schedules were available. The decennial population returns as to dates of births, however, by no means afford a satisfactory substitute for records made immediately or within a few days after the occurrence of the births; moreover, they do not cover the cases of children who have been born and have died during the interval elapsing between two successive censuses.

In death registration the United States has made greater progress than in birth registration. Nevertheless, only 26 States, 46 cities in other States, and the District of Columbia maintain mortality records of sufficient accuracy to justify the Census Bureau in accepting them as authoritative. These States and cities contain about 70 per cent of the total population of the country.

It is highly desirable that the birth and mortality records of every municipality or county should be made reliable, permanent, and readily available for reference; and the only way to insure the existence of this condition in all localities throughout the country is to place the matter under Federal control.

Thus far the only legislative action taken by the Federal Government toward the improvement of vital statistics is found in a joint resolution of Congress, approved February 11, 1903, requesting State authorities to cooperate with the Census Bureau in securing a uniform system of birth and death registration. The Census Bureau itself has conducted a propaganda in the interest of better birth and death registration by the States, and has achieved some success. In order, however, that the United States may have complete birth and death statistics, comparable with those of the more enlightened foreign countries, it will be necessary either to provide for comprehensive Federal control and supervision of birth and death registration or to wait until the last one of the 48 States shall enact and properly administer adequate laws for the registration of vital data.

After careful consideration of the subject, therefore, I have come to the conclusion, in which I have the support of all my subordinate officials, that by far the most satisfactory and effective means to hasten the day when the entire United States shall have adequate registration of births and deaths would be afforded by placing the matter entirely under Federal control and supervision.

#### **EMPLOYMENT OF TEMPORARY CLERKS, STENOGRAPHERS, AND MACHINE OPERATORS.**

In view of the facts that many of the Census Bureau's inquiries are made at decennial or quinquennial intervals and that the amount of work of certain kinds in connection with its annual inquiries varies greatly from month to month, it is highly important, in the interest of good administration, that legal provision be made for the needed elasticity in the clerical and machine-operating forces. A bill (H. R. 2359) authorizing the temporary employment of clerks, stenographers, and machine operators, to be selected from the registers of the Civil Service Commission, has been introduced in the House of Representatives, and its enactment into law is recommended.

#### **FINANCIAL STATISTICS OF STATES.**

Financial statistics of States are now being collected annually under authority of an order issued by the Secretary of Commerce. Legislative authority for making the inquiry a permanent one is desirable, however, and a bill to provide such authority (H. R. 2358) is now before the House of Representatives. Its enactment into law is recommended. The statistics in question are of great value to State officials and others, who are desirous that the investigation be made regularly hereafter.

#### **TOBACCO STATISTICS.**

The law providing for the collection of quarterly statistics of stocks of leaf tobacco held by manufacturers and dealers requires that the blanks be mailed 10 days before the date to which the report relates

and gives the persons reporting 10 days after that date in which to prepare and forward their returns. The time elapsing between the date on which the blanks are received and that on which they are filled out and returned to the Census Bureau—almost three weeks in most cases—is thus so great that many of them are mislaid or lost, with the result that the receipt of the returns and consequently the publication of the reports are delayed.

The law requires an affidavit, which compels a needless expense in places where there is no deputy collector of internal revenue, who is required to administer the oath without charge. This at times occasions delay, since some wait for a visit from the deputy collector in order to save the expense of making the affidavit before a notary public or other official.

It is recommended that the law be amended (1) to provide for mailing the blanks 5 days, instead of 10, before the date to which the report relates, and to allow only 5 days, instead of 10, after that date in which to prepare and forward the returns; and (2) to empower and require the postmaster or assistant postmaster to administer the necessary oath without expense.

#### OFFICIAL REGISTER.

I desire to renew the recommendations for changes in the scope of the Official Register of the United States which have appeared in the annual reports of the Director of the Census for the fiscal years 1913 to 1916, inclusive, and to emphasize the necessity for them. These changes comprise:

1. The establishment of a card directory, prepared and maintained by the Civil Service Commission from information furnished by the executive departments and independent offices, showing the name and status of every person in the Government service except the officers and enlisted men of the Army, Navy, Marine Corps, and Coast Guard. (Lists of officers of the Army, Navy, and Marine Corps are already published annually in the Army Register and Navy Register, issued by the War and Navy Departments, respectively.)

2. The elimination from the Official Register of detailed lists of all employees, by name.

3. The publication annually by the Bureau of the Census of an Official Register containing—

- (a) A list of all employees of the Government (except officers and enlisted men in the Army, Navy, Marine Corps, and Coast Guard) whose duties are of an executive, supervisory, technical, or professional character and whose compensation is \$2,000 or more per annum.

- (b) Statistics relating to the Government service, to be prepared from the Civil Service Commission's card directory.

The Official Register is published biennially. The law directing its compilation provides that the information concerning each employee in the Government service shall be as of July 1. In order to make the register as useful as possible, this law, during the period in which the register has been compiled by the Bureau of the Census, has been disregarded to the extent that all important changes after that date to the time of going to press have been included, so far as practicable; but as the register can not be issued until more than five months after the date to which the information is supposed to refer, it is, in its present form, even under normal conditions, a very unsatisfactory and incomplete publication. The conditions of the past year have emphasized the necessity for making the recommended changes in the method of publishing the register. Important services of the Government have been organized since July 1, and although



they have been included there have been many changes in their personnel which it has been impossible to record, despite the fact that every effort has been made to do so.

If the material in the register were confined, as has been recommended, to a presentation of the organization of each of the bureaus and independent offices, with a full list of the administrative and supervisory officials, together with tables showing, so far as practicable, the numbers of employees in the various grades and classes, it would convey all the information concerning Government departments and personnel which should be of general interest. The adoption of the plan outlined above would also result in a very considerable reduction in the expense of preparing the Official Register and at the same time would provide for a complete and up-to-date record of the entire personnel of the Government in one central office (the Civil Service Commission), in such form that the Census Bureau would be able, by the aid of its tabulating machinery, quickly and accurately to compile statistics relating to Federal employees when called upon to do so by the President or by Congress.

A bill (H. R. 2354) embodying the desired changes in the scope of the Official Register is now before the House of Representatives, and its enactment into law is strongly urged.

#### FOREST PRODUCTS.

In my last two reports I recommended the enactment of legislation providing for the annual collection of statistics of forest products. A bill (H. R. 2357) containing a provision of this character is now before the House of Representatives. Statistics of forest products are of more than ordinary importance at this time and should be collected and published regularly.

#### EXPRESS BUSINESS.

I renew the recommendation contained in my last two annual reports for the repeal of the requirement of a decennial collection of statistics relating to the business of express companies, now contained in the act of June 7, 1906. It would be an unnecessary duplication of work for the Census Bureau to make decennial collections of these statistics, in view of the fact that annual statistics of the same character are collected and published by the Interstate Commerce Commission.

A bill (H. R. 2353) providing for the repeal of the requirement of law in question has been introduced in the House of Representatives.

#### WEIGHT OF CENSUS MAIL MATTER.

It is important that suitable provision be made for the transportation by mail, both to and from Washington, of the Bureau's supplies used in connection with census inquiries, regardless of the size and weight of the boxes in which they are packed. Although the Bureau's needs in this regard are very much greater during a decennial census than at other times, it is, nevertheless, important that it be authorized at all times to have its mail transported in boxes of suitable and convenient size. To this end, the enactment of H. R. 4449 is recommended.

## SPECIAL STATISTICAL COMPILATIONS.

I also renew the recommendation contained in my last two reports to the effect that express, rather than implied, authority be given the Director of the Census to prepare special statistical compilations, as well as to furnish transcripts of tables and other records, for State and local officials and for private concerns and individuals, and that the provision of law conferring this authority be so drawn as to make the amounts received for work of this character actually serviceable to the Bureau instead of only nominally so as at present. The authority under which the Bureau now performs this work is found in section 32 of the Thirteenth Census act. A bill (H. R. 2360) conferring upon the Director of the Census the desired authority has been introduced in the House of Representatives.

## OFFICE ROOM AND STORAGE SPACE.

Less than two years will now elapse before the beginning of the Fourteenth Census period (July 1, 1919), and it is imperative that early consideration be given to the matter of providing suitable office accommodations for the Bureau during that period, as well as adequate permanent storage space for its records.

During the Thirteenth Census period (1909-1912) the greater part of the Census Bureau's force occupied two adjoining buildings and the remainder was housed in two other buildings, one of which was nearly a mile from the main office. The total floor space occupied by the Bureau in these four buildings amounted to nearly 200,000 square feet, and the total annual rental was \$40,000 (no rental being charged for the 8,700 square feet of floor space occupied in the Maltby Building). The total floor space, exclusive of halls, toilet rooms, etc., occupied by the Census Bureau in the Commerce Building on June 30, 1917, was approximately 74,000 square feet, of which about 8,000 square feet represented storage space.

In view of the fact that the Bureau during the next decennial census will have a force about seven times as large as at present and will need about 275,000 square feet of space, including storage, the impossibility of accommodating it in the Commerce Building during that period is apparent. It would be unfortunate and expensive to have the force split up into four separate elements, as it was at the last census. It is recommended, therefore, that arrangements be made for the provision of a building suitable for the accommodation of the additional force of the Census Bureau during a decennial census period.

The urgency of this matter can not be too strongly emphasized.

In reference to storage space, the following excerpt from my last report applies with equal force to present conditions:

The matter of storage space for the Bureau's old records is steadily becoming more serious. These records consist in large part of population, agricultural, and manufactures schedules—that is, the returns made by the enumerators—of past censuses. The population schedules constitute substantially complete lists of the inhabitants of the United States at decennial intervals from 1790 to 1910. These schedules—which show not only names and addresses but various other items of information, such as sex, age, marital condition, etc.—are thus of great value to genealogists, applicants for pensions or increases of pensions, litigants in connection with the settlement of estates, and others; and their destruction would mean irreparable loss. At present these schedules are stored in four places—the eighth floor of the Commerce Building; the fireproof vault in the basement; a portion of the basement outside the vault; and the old Armory Building at the corner of Fifteenth and E Streets NW.

One end of the vault is next to the boiler room, and all the steam pipes for one side of the building pass through it. For this reason the temperature—although the windows are left open and the steam kept shut off from the radiators—can not be brought below 90° F. while the heating plant is in operation. It is, therefore, almost impossible for a clerk to work in the vault, and particularly in the end next to the boiler room, for more than a few minutes at a time; and the records are rapidly deteriorating because of the heat.

The old Armory Building is unlighted and is exceedingly damp and moldy. The roof and walls were formerly in a leaky condition, with the result that some of the records stored there were so badly injured by the rain that portions of them were obliterated.

It is highly important that prompt steps be taken to remedy the conditions above set forth.

### APPROPRIATIONS AND EXPENDITURES.

#### FINANCIAL STATEMENT, FISCAL YEAR 1917.

The following financial statement covers the operations of the Census Bureau during the fiscal year ended June 30, 1917:

<b>Administrative:</b>			
Salaries for administrative places.....	\$35,679.00		
Salaries for division of correspondence and mail.....	11,198.63		
Salaries for labor force.....	4,227.96		
Contingent expenses <sup>a</sup> .....	16,365.62		
		<b>\$67,471.20</b>	
<b>Machine shop:</b>			
Salaries.....	17,496.67		
Materials, supplies, etc.....	7,402.77		
		<b>24,899.44</b>	
<b>Division of revision and results:</b>			
Supervision.....	6,790.74		
Publications.....	3,789.95		
Dependent, defective, and delinquent classes.....	12,500.91		
Official Register of the United States.....	80.84		
Negroes in the United States.....	11,382.78		
Directory of institutions.....	729.08		
Executive civil service.....	7,181.27		
Editorial and result work.....	23.34		
Miscellaneous.....	4,728.84		
		<b>47,267.20</b>	
<b>Division of population:</b>			
Supervision.....	8,922.15		
Occupations.....	30,068.41		
Marriage and divorce.....	1,034.25		
Religious bodies.....	56,808.44		
Preparation for Fourteenth Census.....	2,087.78		
Miscellaneous.....	588.42		
		<b>99,509.45</b>	
<b>Division of manufactures:</b>			
Supervision.....	7,879.57		
Quinquennial census of manufactures.....	173,969.24		
Cotton statistics.....	259,036.36		
Tobacco statistics.....	11,363.23		
Transportation by water.....	97,502.66		
Electrical industries.....	237.68		
Shipbuilding.....	303.34		
Edible oils.....	190.79		
		<b>550,512.87</b>	
<b>Division of vital statistics:</b>			
Supervision.....	7,169.75		
Mortality statistics.....	110,700.46		
Birth statistics.....	38,012.96		
Life tables.....	2,253.97		
Occupational mortality.....	705.01		
		<b>158,842.14</b>	
<b>Division of statistics of cities:</b>			
Supervision.....	7,976.13		
Financial and general statistics.....	82,994.33		
State statistics.....	18,968.91		
		<b>109,939.37</b>	
<b>Geographer's division: Salaries.....</b>		<b>30,938.61</b>	
<b>Special population census.....</b>		<b>890.81</b>	
<b>Salaries of employees detailed to Department of Commerce.....</b>		<b>1,401.60</b>	
<b>Printing and binding<sup>a</sup>.....</b>		<b>115,971.35</b>	
<b>War Department work (registration).....</b>		<b>2,671.73</b>	
<b>Liberty Loan work.....</b>		<b>2,720.67</b>	
<b>Grand total.....</b>		<b>1,213,086.63</b>	

<sup>a</sup> Paid from appropriation for Department of Commerce; no separate appropriation for Bureau of the Census.

Title of appropriation.	Appropriation.	Expenditures during fiscal year.
Salaries, Bureau of the Census, 1917.....	\$673,460.00	\$658,243.94
Collecting statistics, Bureau of the Census, 1917.....	512,000.00	397,556.18
Tabulating machines, Bureau of the Census, 1917.....	25,000.00	24,899.44
Contingent expenses, Department of Commerce, 1917 *.....	16,365.62	16,365.62
Printing and binding *.....	115,971.35	115,971.35
Total.....	1,342,796.97	1,213,036.53

\* Paid from appropriation for Department of Commerce; no separate appropriation for Bureau of the Census.

#### APPROPRIATIONS, FISCAL YEAR 1918.

The Census Bureau's appropriations for the fiscal year 1918 amounted to \$1,383,460. The amount appropriated for salaries was increased from \$673,460 to \$676,460, the change being due to the creation of a new position of chief statistician at \$3,000 per annum.

The appropriation for collecting statistics was increased from \$512,000 to \$647,000. This change is accounted for mainly by the inclusion in the current appropriation of an item for the electrical-industries inquiry, no similar item having been contained in the appropriation for the preceding year, and by increases in the items for the marriage and divorce inquiry and for collection of birth statistics.

The appropriation for experimental work in developing, improving, constructing, and repairing tabulating machines was increased from \$25,000 to \$60,000. Of this amount, \$30,000 will be used to provide for new construction, rebuilding, and overhauling of the types of tabulating machinery now in use by the Census Bureau, in preparation for the work of the Fourteenth Census; and the remaining \$30,000 has been set aside for use in the development of an integrating counter.

Respectfully,

SAM. L. ROGERS,  
*Director of the Census.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*



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**REPORT**  
**OF THE**  
**COMMISSIONER OF FISHERIES**

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# **REPORT**

## **OF THE**

### **COMMISSIONER OF FISHERIES.**

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**DEPARTMENT OF COMMERCE,  
BUREAU OF FISHERIES,  
*Washington, October 4, 1917.***

**SIR:** There is submitted herewith a report covering in outline the operations and activities of the Bureau of Fisheries during the fiscal year ended June 30, 1917.

#### **GENERAL ADMINISTRATIVE CONSIDERATIONS.**

The past fiscal year may properly be regarded as the most important and successful in the recent history of the Bureau. The service was better equipped than ever before in both material facilities and personnel; it received liberal financial support from Congress and generous criticism and appreciation from the public; it was enabled to extend and expand its activities so as to serve in a most acceptable manner a large usefulness to the fishing industry and the country at large; it was privileged to make special adaptation of its investigational and technical operations to meet the great national emergency; and at the beginning of the current fiscal year its outlook for continued and increased usefulness in all lines of activity was most promising.

The Bureau's administrative staff at headquarters at the beginning of the fiscal year consisted of H. F. Moore, Deputy Commissioner; Irving H. Dunlap, assistant in charge of office; Henry O'Malley, assistant in charge of fish culture; Robert E. Coker, assistant in charge of inquiry respecting food fishes and the fishing grounds; Alvin B. Alexander, assistant in charge of statistics and methods of fisheries; and Ward T. Bower, chief agent of the Alaska service. On October 31, 1916, the death of Mr. Alexander deprived the Bureau of an able and loyal employee, who had been in the service since 1887 and chief of division since 1903. He was succeeded by Lewis Radcliffe, who has been in the Bureau since 1907, serving for two years as director of the biological laboratory at Beaufort, N. C., and later as assistant in the division of scientific inquiry. To each of the foregoing and to the rank and file throughout the country the Commissioner extends his appreciative thanks and commends them to the Secretary for efficient and faithful service that has made the year exceptionally fruitful.



The appropriations for the Bureau of Fisheries for the fiscal year 1917 aggregated \$1,144,850, as follows:

Salaries.....	\$427,350
Miscellaneous expenses:	
Administration.....	10,000
Propagation of food fishes.....	360,000
Maintenance of vessels.....	80,000
Inquiry respecting food fishes.....	42,000
Statistical inquiry.....	7,500
Protecting sponge fisheries.....	3,000
Protecting seal and salmon fisheries of Alaska.....	75,000
Investigating damages to fishes.....	25,000
Completion of and improvements at stations:	
Gloucester, Mass.....	3,000
Duluth, Minn.....	2,000
Key West, Fla.....	25,000
Lobster-rearing plant.....	5,000
Two steel distribution cars.....	40,000
Two motor boats, Alaska service.....	10,000
Buildings and improvements, Pribilof Islands, Alaska.....	20,000
Repairs, steamer <i>Albatross</i> (deficiency).....	10,000

A detailed report of the expenditures under each of these appropriations will be submitted in accordance with law.

### THE COMMERCIAL FISHERIES.

#### OUTLINE OF ACTIVITIES.

The activities of the Bureau in relation to the commercial fisheries, over which it should be understood the Government exercises no jurisdiction or supervision except in Alaska, have included the following subjects during the fiscal year 1917: Canvass of the entire fishing industry of the Pacific States; canvass of the shrimp industry of the South Atlantic and Gulf States; collection of detailed statistics of the vessel fisheries centering at Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash., and the publication of this information for the use of the trade in monthly and annual one-sheet bulletins; practical studies of the methods of preparing fishery products for food, fertilizer, and other purposes; prosecution of an active campaign for the more extensive production, distribution, and utilization of fish for food, particularly certain species that have heretofore entered into the food supply only to a limited extent; demonstrations and investigations addressed to the proper and more complete utilization of waste products of the fisheries; practical assistance to the fishermen through demonstration of new or improved methods of handling and preparing their catch; aid in establishing and promoting a hydroid fishery in United States waters; investigations of new aquatic sources of leather, and conduct of active work in the interests of fishermen and tanners looking to the use of skins of various fishes and other water animals in manufacturing leather; and the dissemination among fishermen and fish packers of a very large amount of descriptive matter on the preservation and utilization of fishery products.

#### SHRIMP INDUSTRY OF THE SOUTH ATLANTIC AND GULF STATES.

One of the most important fisheries of the South Atlantic and Gulf States is that for shrimp. The Bureau has recently completed a canvass of this industry for 1916, which reveals a surprising growth

as compared with previous canvasses. The aggregate catch in that year was 43,942,105 pounds with a value of \$758,620, an increase of 136.7 per cent in quantity and 72.9 per cent in value over the last canvass, that of the Bureau of the Census for 1908. Louisiana still remains the center of the industry, over 41 per cent of the entire catch, or 18,160,586 pounds, being accredited to it; Florida is second with 11,549,175 pounds; Mississippi third with 8,899,350 pounds; and Georgia fourth with 4,261,480 pounds. The remaining States of North Carolina, Texas, South Carolina, and Alabama ranking in the order named, produced less than 2.5 per cent of the entire catch.

The number of persons engaged in the industry was 9,235, of whom 3,645 were fishermen, 89 on transporting vessels, and 5,501 in the shore industries. The investment in boats, fishing apparatus, shore and accessory property, and cash capital aggregated \$2,484,625, and the wages paid in the canning and drying industries amounted to \$246,775. The cost of cans, paper linings, labels, and cases for canned shrimp was \$331,162. The wholesale trade in raw, dry-cooked, and pickled shrimp totaled 5,780,090 pounds, valued at \$430,123.

Three marine species of shrimp are taken for commercial purposes. Of these the most important and abundant form is *Penaeus setiferus*, which occurs throughout the range of the fishery from Beaufort, N. C., to Corpus Christi, Tex. The closely related species *P. brasiliensis* is much less abundant and may be distinguished from the other by the character of the groove along each side of the rostrum which extends nearly to the posterior margin of the carapace, while in *P. setiferus* this groove extends less than halfway back. As the fishermen do not recognize these differences, an estimate of the relative importance of *P. brasiliensis* is difficult. The third species, *Xiphopenaeus kroyeri*, commonly known to the fishermen as "sea-bobs" or "seven-beards," is considerably smaller, differs in color and general appearance, and has a rostrum as long as or longer than the carapace instead of shorter, as in the species of *Penaeus*. It is taken commercially only on the Louisiana coast, where it is used solely for drying when the larger species are unobtainable.

On the Atlantic coast the bulk of the shrimp are taken with otter trawls and on the Gulf coast with haul seines, except in Texas where cast nets are used almost exclusively. At Apalachicola, Fla., and Biloxi, Miss., the otter trawl has recently been introduced and is expected to play an increasingly important part in the shrimp fishery of the Gulf coast. In the trawl fishery, motor boats with crews of one to three men are employed. In the Mississippi haul-seine fishery, sail schooners about 40 feet in length serve to carry the fishermen to the fishing grounds, 25 to 80 miles distant, and the catch to the factory. In operating the seine a motor boat and a rowboat are used. The seines range from 175 to 250 fathoms in length and 11 to 18 feet in depth and are operated by crews of 6 men. In Louisiana, the fishermen establish camps near the fishing grounds, the latter being visited in open motor boats. The haul seines employed in this State average about 300 fathoms in length. Gasoline luggers make frequent trips to the fishing grounds to transport the catch to the canning factories, most of which are located in New Orleans.

The irregularity of the movements of the shrimps makes it difficult to define the seasons of abundance in the various waters. In general,

the season in North Carolina is August to November; in South Carolina July to November; in Georgia and east Florida the year round, with irregular slack periods; in west Florida October to July; in Mississippi March, April, and July to December; in Louisiana February to May and July to November; in Galveston Bay, Tex., March to November; and in Corpus Christi Bay, Tex., throughout the year with longer or shorter periods of slackness. The introduction of the otter trawl in Mississippi may lengthen the season in that State.

In 1916, 448,443 cases of canned shrimp, with a value of \$1,436,851 were produced. The principal canning center is Biloxi, Miss., at which place not less than 13 plants are operated. New Orleans is second in importance. Shrimp were also canned at Houma, La.; Lakeshore, Bay St. Louis, Pass Christian, and Ocean Springs, Miss.; Apalachicola, Fernandina, and Nassauville, Fla.; Valona and Brunswick, Ga.; and Southport, N. C.

The canning operations are quite simple. The meat is separated by hand from the heads and shells, thoroughly washed in fresh water, and cooked in wooden tanks for 5 to 10 minutes in boiling water to which sufficient salt for seasoning has been added. The meat is then spread on wire-meshed trays to cool and is then packed in the cans by hand. The cans are of two sizes, holding about 4 and 8 ounces of meat, respectively. For the dry pack, the cans are lined with parchment paper cut to size by the dealer supplying it. The paper prevents the discoloration which results when the meat is in direct contact with the tin. In the wet pack most operators have abandoned the use of the lining without unfavorable results. For this pack the cans are filled with brine. After capping, the cans are processed in steam-tight retorts at 240° F., the smaller cans for 8 to 10 minutes and the larger cans for 12 to 14 minutes; the dry-pack cans for 60 to 70 minutes.

The drying of shrimp is an important industry in Louisiana, fully half the catch being preserved in this manner. Most of the drying is done along the shores of Barataria and Timbalier Bays. Without removing heads or shells, the shrimp are boiled for about 30 minutes in large kettles of water to which salt has been added in the proportion of 10 to 20 quarts, depending on weather conditions, for each 900 pounds of shrimps. They are then spread on large wooden drying platforms at a depth not to exceed 2 to 3 inches and dried in the sun, being turned over every 20 or 30 minutes. Under favorable weather conditions, the drying is completed in 1 or 2 days. The shrimp are then pushed into circular piles and the meat threshed out by workmen walking round and round over them. This primitive method of freeing meat from heads and shells is termed "dancing the shrimp." The meat is then separated from the shells by sifting and packed in barrels for shipment. The product is sold for food in Cuba, Central and South America, and in a number of large cities in the United States. The heads and shells which have been more or less pulverized into a meal or bran by the dancing process are sacked and sold for fertilizer. In 1916, this industry yielded 1,368,346 pounds of dried shrimp, valued at \$183,144 and 684 tons of fertilizer valued at \$12,067. Statistics of the industry in detail are given in the following table:

## SHRIMP INDUSTRY OF THE SOUTH ATLANTIC AND GULF STATES, 1916.

Items.	North Carolina, South Carolina, and Georgia. <sup>c</sup>		Florida.		Alabama and Missis- sippi. <sup>b</sup>		Louisiana.		Texas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Persons engaged:												
On vessels fishing.....	31		24		c 751		8				811	
On vessels transporting.....					49		49				89	
In shore or boat fisheries.....	369		502		1,029		1,029		223		2,884	
In canning industry.....	700		661		2,450		1,947				5,388	
In drying industry.....							113				113	
Total.....	1,090		1,217		3,357		3,943		223		9,235	
Wages paid:												
In canning industry.....		\$33,866		\$48,068		\$80,663		\$65,838				\$228,126
In drying industry.....								16,650				16,650
Total.....		\$33,866		48,068		80,663		84,188				246,776
Cost of cans, paper linings, labels, and cases for canned shrimp.....		42,946		76,206		134,296		77,714				331,162
Plants:												
Canning.....	6		5		16		8				35	
Drying.....							d 11				11	
Total.....	6		5		16		19				46	
Vessels fishing.....	10	24,000	12	10,400	123	237,475	1	330			146	272,205
Net tonnage.....	86		88		1,610		8				1,792	
Offfit.....		7,900		9,900		94,532		30				112,532
Vessels transporting.....					13	30,545	17	32,460			30	68,035
Net tonnage.....					153		146				299	
Offfit.....						10,180		28,152				33,340
Gasoline boats.....	120	101,950	246	166,250	59	36,140	201	79,975			455	384,315
Sail and row boats.....	40	600			26	4,720	88	2,550	180	\$3,640	331	11,510
Apparatus—Vessel fisherist.....												
Hand seines.....					123	33,370	1	225			123	33,595
Other trawls.....	21	820	24	840	4	150					49	1,810

<sup>c</sup> These States are considered collectively to avoid disclosure of individual business.<sup>b</sup> As the catch was small and no shrimp were packed in Alabama, that State is combined with Mississippi.<sup>c</sup> Includes 120 men who were also engaged a brief portion of the year in the shore or boat fisheries.<sup>d</sup> This number does not include the outfits used by individual fishermen in drying their own catch.

## SHRIMP INDUSTRY OF THE SOUTH ATLANTIC AND GULF STATES, 1916—Continued.

Items.	North Carolina, South Carolina, and Georgia.		Florida.		Alabama and Missis- sippi.		Louisiana.		Texas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Apparatus—Shore fisheries:												
Haul seines.	16	\$2,460										
Otter trawls.	189	6,150										
Cast nets.	40	240	455	\$14,945	16	\$3,350	178	\$38,255	8	\$500	218	\$44,835
Shore and accessory property:												
In fishery.		2,260				2,475	39	160		1,280	285	1,670
In canning industry.		98,500		68,000		1,100		8,425				11,735
In drying industry.						266,800		317,000				748,300
Cash capital:												
In canning industry.		76,000		120,000		270,800		174,197				640,997
In drying industry.								25,500				25,500
Total.		319,870		386,335		994,653		779,947		5,720		2,494,625
PRODUCTS.												
Catch of shrimp:												
Vessel fisheries—												
With haul seines.												
With otter trawls.	680,200	15,770	948,295	14,452	7,426,350	130,133	14,400	216			7,440,750	130,349
With cast nets.					200,000	3,000					1,823,485	33,222
Total.	680,200	15,770	948,295	14,452	7,626,350	133,133	14,400	216			9,269,245	163,571
Shore fisheries—												
No. 1 cans.	323,945	9,322			338,250	6,391	18,100,186	283,819	3,314	165	18,773,695	219,498
With haul seines.	3,631,280	88,601			639,750	17,900	46,000	1,270	321,255	17,514	15,471,910	324,167
With otter trawls.	60,000	2,400									427,255	21,184
With cast nets.												
Total.	4,325,225	100,324	10,600,880	217,666	1,278,000	24,291	18,146,186	285,089	324,569	17,679	34,672,860	585,049
Grand total.	5,005,425	116,094	11,549,175	232,118	8,902,350	157,424	18,160,586	235,305	324,569	17,679	43,942,105	738,620
Canned shrimp:												
Wet pack:												
No. 1 cans.	25,981	86,544	69,913	221,148	103,984	322,515	68,271	200,793			263,149	831,000
No. 1½ cans.	1,613	5,553	6,586	19,778	4,517	14,617	7,343	23,870			20,659	63,818
Dry pack:												
No. 1 cans.	20,379	71,578	26,297	82,121	46,709	151,435	35,995	118,439			129,370	423,573
No. 1½ cans.	12,233	41,249	6,080	18,678	11,125	37,768	5,427	17,767			35,865	118,460
Total.	61,206	207,924	108,896	341,725	166,335	526,333	112,036	360,869			448,443	1,436,851

Dried shrimp.....	pounds.....	1,368,346	183,144	1,368,346	183,144
Fertilizer (shells and heads).....	tons.....	684	12,067	684	12,067
Total.....			185,211		185,211
Grand total.....			556,080		1,632,002
WHOLESALE TRADE IN RAW, DRY-COOKED, AND PICKLED SHRIMP.					
Products sold:					
Raw shrimp—					
Whole.....	pounds.....	490,039	27,819	58,498	2,810
Boned.....	do.....	3,157,901	273,297		
Whole.....	pounds.....	104,000	4,638		
Boned.....	do.....	98,060			
Peeled.....	do.....	65,000			
Pickled.....	do.....	7,020			
Total.....		965,473	305,754	58,498	2,810

e 48 cans to a case.

b 24 cans to a case.

COMPARATIVE STATISTICS OF THE SHRIMP CATCH OF THE SOUTH ATLANTIC AND GULF STATES FOR VARIOUS YEARS FROM 1880 TO 1916.<sup>a</sup>

Year.	North Carolina.	South Carolina.	Georgia.	Florida.	Alabama.	Mississippi.	Louisiana.	Texas.	Total.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
1880.....	63,000	\$4,500	\$37,500	\$3,500	(b)	(b)	534,000	\$41,760	1,992,250
1887.....	120,110	4,603	18,400	(b)	(b)	(b)	6,809,680	96,408	8,852,223
1888.....	124,000	4,650	18,860	152,000	43,750	1,092,800	9,942,700	254,633	7,950,184
1889.....	135,240	5,100	380,400	150,000	80,000	784,200	16,741	7,238,500	95,882
1890.....	144,200	5,435	371,840	18,592	(b)	(b)	613,500	12,622	90,519
1895.....	(b)	(b)	(b)	62,625	(b)	(b)	6,602,050	(b)	(b)
1897.....	146,496	5,885	374,500	18,395	67,400	1,903,165	28,804	4,486,798	80,576
1902.....	84,160	2,700	344,127	8,408	3,030,134	63,218	7,634,720	131,715	290,815
1908.....	371,000	9,000	528,000	19,000	4,333,000	81,000	8,581,000	213,000	118,000
1916.....	683,945	16,323	2,400,426	97,371	11,546,175	232,118	157,382,180	324,569	17,679,432

<sup>a</sup> The statistics for 1908 in this table are from data published by the Bureau of the Census.<sup>b</sup> Statistics not available.

## NEW ENGLAND VESSEL FISHERIES.

Statistics of the vessel fisheries centering at Boston and Gloucester, Mass., and Portland, Me., have been collected during the year by the local agents and published promptly in monthly bulletins showing, by species and fishing grounds, the quantities and values of fishery products landed by American fishing vessels at these ports. Two annual bulletins also have been issued, one showing the catch by months and the other by fishing grounds.

The fleet landing fishery products at these ports in 1916 included 512 sail, steam, and gasoline screw vessels. These vessels landed at Boston 3,089 trips, aggregating 98,331,038 pounds of fish, valued at \$3,702,365; at Gloucester 2,864 trips, aggregating 66,680,548 pounds, valued at \$2,159,894; and at Portland 2,992 trips, aggregating 20,812,839 pounds, valued at \$521,647. The total for the three ports amounted to 8,945 trips, aggregating 185,824,425 pounds of fresh and salted fish, having a value to the fishermen of \$6,383,906. No comparison with previous returns can be made for Portland, as this is the first year the products landed at that port have been included in these statistics. At Boston and Gloucester, as compared with the previous year, there was a decrease of 1,291 trips and of 6,584,142 pounds in the quantity, but an increase of \$1,124,342 in the value of the fish landed. The catch of cod decreased 4,489,950 pounds, haddock 2,684,498 pounds, hake 4,258,410 pounds, cusk 1,085,389 pounds, halibut 947,234 pounds, and swordfish 483,345 pounds, but all of these species increased in value except hake, which declined about 1 per cent. The mackerel catch increased 4,225,945 pounds, or 38.70 per cent in quantity, and \$396,331, or 64.54 per cent in value. There was also considerable increase in the quantity and value of herring, pollock, and miscellaneous products. The catch of Newfoundland herring decreased 26,715 pounds, or less than 1 per cent, in quantity, but increased \$70,275, or 27.48 per cent, in value. The catch of tilefish landed at Boston during the year amounted to 873,142 pounds, having a value of \$24,295.

The following tables present in detail, by fishing grounds and by months, the products of the vessel fisheries of Boston and Gloucester, Mass., and Portland, Me., for the calendar year 1916. The weights of fresh and salted fish given in these statistics represent the fish as landed from the vessels, and the values are those received by the fishermen. The grades, or sizes, given for certain species are those recognized in the trade.

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1916, SHOWN BY FISHING GROUNDS.

Fishing grounds.	Num-ber of trips.	Cod.							
		Large (10 pounds and over).		Market (under 10 and over 2½ pounds).		Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.									
East of 68° west longitude.									
La Have Bank.....	18	68,223	\$2,430		106,960	\$2,607	9,239	\$127	
Western Bank.....	74	427,664	19,283		657,179	21,358	35,903	917	
Quebec Bank.....	5	38,540	1,385		43,360				
Green Bank.....	1	20,000	1,000						
Grand Bank.....	1								
Burgeo Bank.....	2								
Off Newfoundland.....	4								
Cape Shoreland.....	108	412,466	19,765		477,022	13,171	116,402	1,865	
Gulf of St. Lawrence.....	2								
St. Ann's Bank.....	3	40,935	1,553		73,250	2,079	9,715	129	
West of 68° west longitude.									
Browns Bank.....	224	1,410,321	60,110		1,617,869	45,140	179,196	2,946	
Georges Bank.....	489	2,094,022	104,017		2,210,856	73,365	153,723	2,636	
Cashes Bank.....	16	40,769	1,622		35,680	1,015	2,711	47	
Clark Bank.....	1	600	24		2,000	55			
Fippin's Bank.....	11	16,435	854		16,610	475	449	6	
Middle Bank.....	83	34,945	2,014		44,407	1,896	8,389	175	
Jeffrey's Ledge.....	832	303,362	17,773		298,478	11,570	42,348	900	
Jewfish Bay.....	31	134,582	5,183		29,035	1,114	42,775	14	
South Channel.....	455	644,938	42,457		1,230,410	47,952	182,334	4,572	
Nantucket Shoals.....	98	212,806	13,500		784,068	26,965	145,645	2,403	
Off Highland Light.....	4	3,429	140		2,710	87	146,255	4	
Off Chatham.....	489	1,422,194	80,866		1,725,582	58,068	167,289	2,545	
Off Race Point.....	5								
Bay of Fundy.....	3	4,775	171		6,885	170			
Seal Island.....	6	18,055	1,174		43,890	1,580	6,955	134	
South.....	24								
Shore, general.....	396	300,730	14,326		193,772	6,297	10,569	155	
Total.....	3,089	7,649,811	389,726		9,599,973	315,550	1,071,917	19,605	



QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1916, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Num-ber of trips.	Cod.					
		Large (10 pounds and over).		Market (under 10 and over 2½ pounds).		Scrod (1 to 2½ pounds).	
		Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT GLOUCESTER.							
<i>East of 66° west longitude.</i>							
La Have Bank.....	7	22,510	\$532	31,100	\$690	2,670	\$21
Western Bank.....	46	1,238,650	30,703	1,097,481	24,444	34,108	285
Quebec Bank.....	88	1,795,658	47,815	2,949,912	66,456	115,760	939
Misaine Bank.....	1	27,935	698	154,270	3,548	34,040	255
Green Bank.....	5	15,320	415	1,665	6,850		
Grand Bank.....	43	362,858	9,774	108,034	2,926	75,640	567
St. Peters Bank.....	4	50,200	1,463	15,090	377		
Burgoe Bank.....	1	144,510	3,683	3,950	166		
Off Newfoundland.....	9	177,000	5,485			94,166	2,872
Cape North.....	15	625,050	15,063	267,370	5,945		
Cape Shore.....	33	172,840	4,718	220,970	5,037	10,095	76
Gulf of St. Lawrence.....	14	355,280	8,999	240,970	5,078	9,910	74
St. Ann's Bank.....	8	234,835	5,134	239,770	4,166	10,261	89
The Gully.....	11	21,370	618	13,416	348	15,550	139
Labrador coast.....	1					120	1
<i>West of 68° west longitude.</i>							
Browns Bank.....	31	523,418	13,057	595,795	12,910	40,595	313
Georges Bank.....	117	672,710	15,085	572,046	13,426	24,917	253
Middle Bank.....	17						
South Channel.....	4	860	23	17,275	423		
Nantucket Shoals.....	58	12,805	602	39,410	1,173	960	7
Off Chatham.....	50					1,855	20
Seal Island.....	3	16,060	405	10,820	260		
South.....	1					350	2
Shore, general.....	2,255	1,433,037	67,013	30,663	696	2,370	17
Total.....	2,864	7,725,906	225,800	6,610,007	148,109	379,201	3,058
						298,725	8,739

LANDED AT PORTLAND.  
East of 68° west longitude.

La Have Bank.....	8	8,502	507	2,790	140	1,885	53	2,415	112	340	5	
Western Bank.....	14	68,305	1,146			105,234	1,452			9,724	111	
Queveau Bank.....	2	4,060	110			3,000	68					
Green Bank.....	1											
Grand Bank.....	7	22,790	520	35,290	1,499			835	33			
St. Peter Bank.....	1	885	23	7,660	345			34,450	1,378	110	1	4,815
Bacallen Bank.....	1											132
Cape North.....	2	29,910	1,458			12,500	533					
Cape Shore.....	4	5,180	120			2,925	66					
The Gully.....	2											
<i>West of 68° west longitude.</i>												
Browns Bank.....	4	5,855	271			1,470	48					
Georges Bank.....	13	89,009	1,654	3,460	175	26,707	649	4,865	210	710	11	
Cashes Bank.....	46	19,965	862			22,204	626			3,965	38	
Jeffreys Ledge.....	57	42,188	2,502			55,251	1,956			8,187	125	
South Channel.....	24	18,068	421			62,878	965			2,893	26	
Shore, general.....	2,806	1,166,076	62,975	2,385	124	966,852	33,655	991	45	229,499	3,665	12
Total.....	2,992	1,440,323	72,569	51,585	2,283	1,290,523	40,240	43,556	1,778	255,428	3,912	5,200
Grand total.....	8,945	16,816,040	688,095	4,498,280	212,140	17,470,503	503,899	2,827,208	117,290	1,706,546	26,575	8,883

## Haddock.

## Hake.

Fishing grounds.	Large (over 2½ pounds).			Serod (1 to 2½ pounds).			Large (6 pounds and over).			Small (under 6 pounds).			
	Fresh.		Salted.	Fresh.		Salted.	Fresh.		Salted.	Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
LANDED AT BOSTON.													
<i>East of 66° west longitude.</i>													
La Have Bank.....	220,050	\$5,261	33,425	\$491	98,083	\$3,111	90,259	\$1,811					
Western Bank.....	3,190,600	100,422	817,069	20,669	8,060	192	7,531	286					
Quereau Bank.....													
Cape Shore.....	1,860,265	75,841	194,628	4,471	96,296	4,084	5,102	227					
St. Ann's Bank.....	72,400	3,095	13,220	375			190,447	5,092					
							400	16					

## LANDED AT BOSTON.

## East of 68° west longitude.

La Have Bank.....	220,050	\$5,261	32,425	\$491	98,083	\$3,111	90,259	\$1,811	90,259	\$1,811
Western Bank.....	3,190,600	100,422	817,069	20,669	8,060	192	7,531	286	7,531	286
Queveau Bank.....										
Cape Shore.....	1,860,265	78,841	194,628	4,471	96,296	4,084	5,102	227	5,102	227
St. Ann's Bank.....	72,400	12,250	376				190,447	5,092	190,447	5,092

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1916, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Haddock.				Hake.			
	Large (over 2½ pounds).		Scrod (1 to 2½ pounds).		Large (6 pounds and over).		Small (under 6 pounds).	
	Freesh.	Salted.	Freesh.	Salted.	Freesh.	Salted.	Freesh.	Salted.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON—continued.								
West of 66° west longitude.								
Brown Bank.....	6,104,825	\$233,890	921,856	\$17,017	109,000	\$8,188	201,288	\$4,942
Georges Bank.....	3,733,808	138,341	1,757,680	32,135	58,494	3,060	141,073	3,214
Cashes Bank.....	16,720	543	3,980	91	50,210	1,757	142,866	2,667
Clark Bank.....	8,900	267	1,335	28	108,220	2,625	91,783	1,532
Fippaues Bank.....	322,350	18,532	145,830	4,694	46,231	2,179	220,060	7,801
Middle Bank.....	1,570,999	86,126	611,394	20,289	262,838	13,815	1,293,110	36,510
Jerry's Edge.....	11,535,754	301,078	7,181,255	146,604	580	6	2	50
South Channel.....	12,707	2,818	16,107	225	428,923	14,160	1,063,762	26,769
Norocket Shoals.....	12,470	518	6,415	11	420	11	4,680	184
Off Highland Light.....	4,800,024	171,838	2,318,624	41,065	264,320	9,527	692,071	16,500
Off Cape Cod.....	1,860	37	720	7	51,500	1,740	53,031	1,045
Bay of Fundy.....	92,055	4,024	38,845	912	5,170	190	4,120	90
Sea Island.....	264,363	13,523	87,356	2,752	528,371	18,977	1,307,339	27,570
Shore, general.....								
Total.....	34,351,585	1,215,663	14,199,920	311,844	2,233,267	84,591	5,420,587	136,345
LANDED AT GLOUCESTER.								
East of 66° west longitude.								
La Have Bank.....	102,785	1,410			223,080	2,206		\$56
Western Bank.....	777,185	9,949	56,800	722	273,865	3,919		39
Quebec Bank.....	1,358,081	19,455	20,226	283	792,747	12,984		38,538
Muskele Bank.....	137,735	1,722						
Green Bank.....	33,321	467	14,134	141	45,570	738		160
Grand Bank.....	33,300	6	5	800	162,274	2,617	670	12
St. Peter's Bank.....					22,780	43,245		576
Greenbank Bank.....					30,680	5,680		154
Cape North.....	16,710	220	7,073	143	484	6,910		129
					87,225	1,135		405

Cape Shore.....	170,418	2,079	25,500	512	8,000	88				106,516	2,812	5,822	149				
Gulf of St. Lawrence.....	10,555	127	3,830	89						78,625	1,183	2,490	64				
St. Ann's Bank.....	14,345	100	120	4						7,145	92	510	9				
The Gully.....										40,151	741	425	7				
<i>West of 66° west longitude.</i>																	
Browns Bank.....	1,229,771	16,844			198,038	2,395				82,870	1,071			11,770	147		
Georges Bank.....	1,438,265	23,552	8,483		52,860	634				64,550	976	70	1				
South Channel.....	246,310	3,448		192							8						
Nantuxet Shoals.....	7,060	124	2,105	42													
Seal Island.....										420	5						
Shore, general.....	783,002	26,570	25	1						783,182	22,542	153	3	6,844	460		
Total.....	6,376,223	109,097	78,000	1,595	333,058	4,274	380	9		2,821,172	55,061	136,170	2,783	19,284	619	1,080	16
LANDED AT PORT- LAND.																	
<i>East of 66° west longitude.</i>																	
Le Have Bank.....	22,300	276								25,400	394			5,650	76		
Western Bank.....	1,085,513	13,372			73,710	1,323				4,650	150			9,660	140		
Queveau Bank.....										6,610	99						
Grand Bank.....														4,000	74	845	19
St. Peter's Bank.....	57,080	885	96,780	2,257													
Cape North.....		9															
Cape Shore.....	26,375	646			4,510	45				280	11			4,910	55		
<i>West of 66° west longitude.</i>																	
Browns Bank.....	5,700	201			1,100	28				73,970	1,732			46,625	673		
Georges Bank.....	2,515	32								53,417	1,049			119,970	2,007		
Cashes Bank.....	5,510	206			3,125	39				41,758	2,110			221,052	6,199		
Jeffreys Ledge.....	88,453	4,815	2,910	146	30,386	687	600	18		29,453	422			73,013	812		
South Channel.....	2,001,614	27,222			435,237	5,228											
Shore, general.....	1,186,191	57,562	6,126	258	160,667	3,928	500	10		497,120	15,427	528	27	1,317,223	27,230	4,605	99
Total.....	4,481,916	105,226	104,816	2,661	708,814	11,278	1,100	28		732,688	21,414	528	27	1,802,103	36,266	5,450	118
Grand total.....	45,109,704	1,429,866	182,816	4,256	15,261,792	327,396	1,480	37		5,787,117	161,066	136,698	2,810	7,241,974	173,230	6,510	134

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1916, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Pollock.		Cusk.		Halibut.	
	Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
	Value.	Value.	Value.	Value.	Value.	Value.
LANDED AT BOSTON.						
<i>East of 66° west longitude.</i>						
La Have Bank.....	15,464		181,687	\$5,076	18,968	\$2,904
Western Bank.....	820		7,08	14	30,219	4,339
Quebec Bank.....	96,240		18,500	309	58,075	5,066
Green Bank.....	4				4,000	
Grand Bank.....					183,000	17,200
Purple Bank.....					50,000	5,500
Gulf of St. Lawrence.....	43,485		139,662	3,144	17,420	2,544
St. Ann's Bank.....	425				56,000	5,500
					56,168	76
<i>West of 66° west longitude.</i>						
Brown's Bank.....	272,912		1,612,324	32,561	197,570	32,788
Georges Bank.....	416,647		208,714	4,971	273,703	31,203
Cashes Bank.....	17,230		117,698	2,222	1,732	243
Clark Bank.....	200				3,416	471
Plymouth Bank.....	4,405		79,308	1,483	824	107
Middle Bank.....	23,478				1,853	407
Jeffrey's Ledge.....	1,397,417		444,629	10,426	13,104	2,479
Jeffrey's Bank.....	6,155		1,900	62	1,817	772
South Channel.....	397,970		296,327	5,662	102,697	14,753
Northwest Shoals.....	42,893		2,940	73	37,771	4,668
Off Highland Light.....	802,846		515	15	39,877	6,884
Off Chatham.....	2,410		83,860	1,187	118	280
Bay of Fundy.....	5,800		35,860	664	1,148	
Seal Island.....	275,018		71,068	1,653	8,415	1,410
Shore, general.....			494,335	5,976		
Total.....	3,792,199		3,657,429	77,702	1,141,965	144,128
LANDED AT GLOUCESTER.						
<i>East of 66° west longitude.</i>						
La Have Bank.....	5,625		99,345	1,417	65,069	6,269
Western Bank.....	55,935		191,310	2,824	170,223	17,089
Quebec Bank.....	52,777		505,971	7,963	261,885	26,389
					225	63
					1,020	1,307
					9,126	7,615
					2,836	5,411

Misaine Bank.....	249	1,260	31	560	10	500	10	22,734	3,011	14,307	1,107
Green Bank.....	24	16,010	344	45,520	787	5,310	129	474,808	45,272	1,945	1,06
Grand Bank.....	41	3,250	66	1,575	30	155	5	34,611	4,297	3,800	294
St. Peter's Bank.....	6	3,250	66	1,575	30	155	5	34,611	4,297	3,800	294
Burgo Bank.....	2	3,250	66	1,575	30	155	5	34,611	4,297	3,800	294
Bacallen Bank.....	110	1,033	25	4,400	83	1,580	31	96,445	8,469	3,122	110
Cape North.....	660	1,033	25	4,400	83	1,580	31	96,445	8,469	3,122	110
Cape Shore.....	193	3,350	68	182,430	2,570	2,623	108	33,104	3,802	1,845	1,008
Gulf of St. Lawrence.....	8	1,220	3	6,350	101	1,05	2	56,893	5,658	11,902	1,008
St. Ann's Bank.....	140	105	3	7,480	114	180	5	29,905	2,719	31,807	4,449
The Gully.....	5	105	3	7,480	114	180	5	29,905	2,719	31,807	4,449
Labrador Coast.....											
<i>West of 66° west longitude.</i>											
Browns Bank.....	41,133	31,010	675	144,838	1,848	2,705	69	21,226	1,776	315	26
Georges Bank.....	83,240	31,010	675	188,758	2,568	2,705	69	118,181	11,046	315	26
South Channel.....	920	4,297	85	470	6	5,780	141	51,447	5,938		
Nantucket Shoals.....	2,570	4,297	85	470	6	5,780	141	51,447	5,938		
Seal Island.....	1,230	313	5	104,245	1,299	94	2				
Shore, general.....	9,831,950	78,168	1,635	66,110	841						
Total.....	10,117,193	78,168	1,635	1,553,926	22,283	34,000	869	1,686,252	175,285	95,244	8,510
LANDED AT PORTLAND.											
<i>East of 66° west longitude.</i>											
Le Have Bank.....	2,445	720	22	17,030	271			77,074	8,006		
Western Bank.....	54,066			17,190	250			49,558	4,660		
Quereau Bank.....	200			670	10			34,792	3,942		
Green Bank.....								15,315	1,789		
Grand Bank.....								144,869	16,079		
St. Peter's Bank.....		580	13					12,937	1,493		
Bacallen Bank.....								40,472	2,800		
Cape North.....	1,480			1,380	24			42,768	6,051		
Cape Shore.....								43,121	4,944		
The Gully.....											
<i>West of 66° west longitude.</i>											
Browns Bank.....	775							13,762	1,769		
Georges Bank.....	1,275			2,598	59			42,297	4,880		
Cashes Bank.....	16,622			70,345	1,351			691	82		
Jeffrey's Ledge.....	24,680			142,961	2,867	6,335	47	2,432	283		
South Channel.....	9,094							3,445	176		
Shore, general.....	1,482,488	21,675	368	533,001	13,618	11,435	119	11,723	1,278		
Total.....	1,563,125	22,975	403	805,172	18,450	17,770	166	535,314	57,662		
Grand total.....	15,502,487	101,143	2,038	6,016,537	118,415	51,770	1,035	3,363,521	377,075	95,244	8,510



LANDED AT PORTLAND.							
<i>West of 66° west longitude.</i>							
Shore, general.....	213, 873	11, 792	.....	217, 124	10, 953	1, 055	108
Total.....	213, 873	11, 792	.....	217, 124	10, 953	1, 055	108
Grand total.....	5, 750, 103	354, 184	.....	3, 438, 381	196, 879	2, 283, 986	207, 447
						1, 643, 147	76, 476
							947, 606
							64, 826
Fishing grounds.							
LANDED AT BOSTON.							
<i>East of 66° west longitude.</i>							
		Fresh.		Salted.		Total.	



QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1916, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Miscellaneous.				Total.			
	Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON—continued.								
<i>West of 68° west longitude—Continued.</i>								
Off Highland Light.....	5,800	\$56			43,181	\$1,419		
Off Chatham.....	493,507	9,446			14,087,116	478,280		
Off Race Point.....	8,000	120			107,250	8,229		
Bay of Fundy.....	7,200	166			163,786	4,006		
Seal Island.....	2,945	51			290,031	10,212		
South.....	928,142	26,304			928,142	26,304		
Shore, general.....	340,850	8,407			7,494,714	864,264		
Total.....	6,712,473	375,230			98,254,638	3,685,994		
LANDED AT GLOUCESTER.								
<i>East of 68° west longitude.</i>								
Le Have Bank.....					551,154	13,707		
Western Bank.....					3,901,686	90,667		
Queereen Bank.....					7,649,177	182,700		
Middle Bank.....	260	20			373,690	6,473		
Green Bank.....					88,649	4,213		
Grand Bank.....	735	74			2,521,155	60,616		
St. Peter's Bank.....					1,280,154	6,639		
Burgeo Bank.....					126,076	8,675		
Beaulieu Bank.....					290,085	12,857		
Off Newfoundland.....	3,244,611	118,637			3,244,611	118,637		
Cape North.....					1,027,315	24,215		
Cape Shore.....					979,187	21,398		
Gulf of St. Lawrence.....	250	26			759,522	21,263		
St. Ann's Bank.....					641,850	12,362		
The Gully.....					317,483	33,634		
Labrador coast.....								
<i>West of 68° west longitude.</i>								
Brown's Bank.....					2,839,454	50,811		
Cape Bank.....					3,780,400	79,000		
Middle Bank.....					3,280,838	11,451		
Grand total.								
							Pounds.	Value.
							43,181	\$1,419
							14,086,516	478,280
							107,250	8,229
							163,786	4,006
							290,031	10,212
							928,142	26,304
							7,541,714	368,610
							98,331,038	3,702,365
							599,501	15,296
							4,083,912	90,654
							8,828,179	227,041
							137,680	6,397
							373,384	6,397
							3,901,209	170,299
							1,123,076	8,029
							8,575	517
							548,502	25,351
							10,644,885	307,366
							2,739,044	94,662
							1,706,273	68,145
							1,881,873	74,818
							2,403	14,753
							355,963	36,553
							56,136	5,026
							2,915,699	52,077
							5,403,211	240,067
							8,799,135	66,386

South Channel.....						267,085	3,924	1,310,957	102,100	267,085	3,924
Nantucket Shoals.....						219,842	10,566	1,530,549	112,668	1,530,549	112,668
Off Chatham.....					96	700,878	26,344	523,901	37,093	523,901	37,093
Beal Island.....						184,572	7,994	123,023	11,021	184,572	7,994
South.....								2,000	82	2,000	82
Shore, general.....					41,431	17,263,662	410,581	1,011,310	73,391	18,274,962	483,972
Total.....											
						7,318,533	100,173	7,223,224	183,344	66,680,546	2,159,894
LANDED AT PORTLAND.											
<i>East of 68° west longitude.</i>											
La Have Bank.....						167,708	9,794	5,925	274	173,633	10,068
Western Bank.....						1,483,777	23,158			1,483,777	23,158
Quebec Bank.....						49,697	4,250			49,697	4,250
Green Bank.....					18	15,315	1,780			15,315	1,780
Grand Bank.....					23	172,049	16,696	35,125	1,532	208,174	18,327
St. Peters Bank.....						64,066	1,068	145,130	4,144	209,235	5,212
Becallieu Bank.....						12,937	1,483			12,937	1,483
Cape North.....						83,453	4,800			88,253	4,800
Cape Shore.....						89,856	7,063			96,919	7,063
The Gully.....						43,121	4,944			43,121	4,944
<i>West of 68° west longitude.</i>											
Brown Bank.....						28,647	2,371			28,647	2,371
Georges Bank.....					38	273,641	11,204	8,325	385	283,946	11,588
Cashier Bank.....					1,099	537,119	11,304			527,119	11,304
Jeffrey Ledge.....					4,573	67,582	24,469	9,845	211	698,729	21,703
South Channel.....					76	2,708,792	24,159			2,708,792	24,159
Shore, general.....					73,010	13,864,684	366,088	56,055	1,428	13,910,749	357,516
Total.....											
						6,182,411	71,421	261,445	7,976	20,812,839	521,647
Grand total.....						20,213,467	606,824	20,503,116	983,228	186,824,426	6,383,906

\* See footnote, p. 571.

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE YEAR 1916, SHOWN BY MONTHS.

Month.	Number of trips.	Cod.					
		Large (10 pounds and over).			Market (under 10 and over 2½ pounds).		
		Fresh.		Salted.	Fresh.		Salted.
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.							
January.....	195	447,547	\$23,270	.....	\$13,517	78,189	\$1,212
February.....	184	496,769	26,904	.....	568,061	70,608	1,120
March.....	220	478,426	32,902	.....	16,735	34,737	981
April.....	232	906,503	34,937	.....	956,104	34,627	620
May.....	244	1,801,917	38,703	.....	1,259,076	42,821	624
June.....	261	983,483	43,001	.....	1,120,179	93,910	1,328
July.....	316	669,594	39,243	.....	1,186,357	105,508	1,525
August.....	371	648,315	40,050	.....	1,187,083	170,070	2,848
September.....	315	643,537	37,410	.....	866,120	92,546	1,557
October.....	327	448,431	30,716	.....	519,933	83,444	1,409
November.....	234	316,698	21,558	.....	472,030	143,700	3,198
December.....	190	338,591	21,042	.....	562,263	184,101	3,173
Total.....	3,089	7,649,811	389,726	.....	9,599,973	1,071,917	19,605
LANDED AT GLOUCESTER.							
January.....	197	123,407	3,597	185,025	\$5,818	4,890	\$89
February.....	103	133,373	6,844	28,200	1,772	6,555	19
March.....	174	196,295	11,976	30,115	63,700	8,225	408
April.....	420	1,440,168	61,220	91,750	29,071	14,880	3
May.....	457	1,871,988	49,014	120,881	431,752	18,430	84
June.....	144	1,132,047	27,395	1,209,478	1,510,891	73,857	9,580
July.....	158	897,686	23,723	686,805	33,197	78,102	802
August.....	181	753,130	19,259	52,516	39,478	583,248	1,009
September.....	181	522,563	14,528	32,283	21,681	36,751	313
October.....	145	432,702	9,377	265,260	49,981	44,126	303
November.....	369	119,013	7,032	410,680	15,544	26,037	209
December.....	335	65,548	2,326	203,140	8,026	45,250	1,045
Total.....	2,864	7,725,906	225,800	4,446,066	6,610,007	2,783,712	3,088
						379,201	208,725
						8,739	

## LANDED AT PORTLAND.

LANDED AT PORTLAND.									
	140	77,741	4,366			104,995	3,552		
January.....	171	123,039	10,485			96,946	3,953		30,016
February.....	378	294,379	16,535	500	25	208,048	6,790	615	24,346
March.....	304	234,074	17,438			233,048	8,729		24,327
April.....	301	258,594	17,277			187,639	6,823		17,817
May.....	304	253,094	17,668	3,460	175	187,390	6,823	210	12,714
June.....	196	206,684	17,106	37,920	1,592	153,270	5,318	37	12,714
July.....	148	261,946	17,441	37,340	12	46,474	1,009		3,463
August.....	148	261,946	17,441			46,474	1,009		3,463
September.....	145	46,097	2,138	9,950	460	35,987	730		3,075
October.....	227	78,052	9,732	9,315	19	42,004	1,059	36,976	4,591
November.....	255	101,673	6,263			52,926	2,700	15,313	231
December.....	336	72,164	4,669			98,238	3,829	601	76,176
						136,788	5,711		1,464
Total.....	2,992	1,440,323	72,569	51,585	2,268	1,260,523	40,240	43,556	255,428
Grand total.....	8,945	16,816,040	688,095	4,498,280	212,140	17,470,503	603,899	2,857,263	1,706,546
									26,575
									303,925
Grounds E. of 66° W. long.....	592	6,214,476	178,935	4,125,084	193,000	6,833,833	161,363	2,607,010	489,707
Grounds W. of 66° W. long.....	8,333	10,601,564	506,160	373,196	19,140	10,636,570	842,636	220,258	1,216,589
Landed at Boston in 1915 a.....	3,772	7,181,632	317,597	6,079,925	241,707	11,928,214	283,911	1,109,757	9,795
Landed at Gloucester in 1915 a.....	3,472	7,396,852	170,397	6,079,925	241,707	6,226,910	100,123	3,994,245	14,585
									2,057
									292,908
									7,662

## HADDOCK.

## HAKE.

Month.	Large (over 2½ pounds).		Scrod (1 to 2½ pounds).		Large (6 pounds and over).		Small (under 6 pounds).	
	Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.								
January.....	2,614,970	\$12,289	715,491	\$21,580	113,507	\$5,744	239,108	\$8,306
February.....	3,574,773	130,650	1,359,415	31,260	46,709	4,510	107,520	4,300
March.....	3,515,847	174,584	1,130,962	42,881	48,980	3,350	505,619	6,571
April.....	4,371,590	94,314	1,161,046	15,583	119,583	10,710	538,108	10,710
May.....	2,410,927	63,873	1,156,134	17,525	244,459	6,552	723,447	11,176
June.....	2,028,340	70,105	1,354,065	20,917	230,035	7,378	465,367	8,666
July.....	2,134,437	59,595	1,262,190	16,790	201,035	6,254	412,747	8,266
August.....	3,072,192	79,674	1,464,448	22,699	268,051	8,974	523,506	11,066
September.....	3,215,211	85,459	1,355,467	20,922	356,023	11,411	572,676	12,488
October.....	3,046,876	118,774	1,281,247	33,306	242,384	11,524	738,735	21,266
November.....	2,184,829	103,177	1,261,554	31,602	194,578	8,261	605,528	17,697
December.....	2,131,676	124,169	953,371	36,839	107,713	6,510	387,909	15,694
Total.....	34,351,565	1,215,663	14,199,920	311,844	2,233,257	84,591	5,420,387	136,345

a Statistics of the fishery products landed at Portland in 1915 are not available for the entire year, and are therefore not shown in this statement.

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE YEAR 1916, SHOWN BY MONTHS—Continued.

Month.	Haddock.						Hake.					
	Large (over 2½ pounds).			Scrod (1 to 2½ pounds).			Large (6 pounds and over).			Small (under 6 pounds).		
	Fresh.	Salted.	Value.	Fresh.	Salted.	Value.	Fresh.	Salted.	Value.	Fresh.	Salted.	Value.
LANDED AT GLOUCESTER.												
January.....	Pounds 31,524	Pounds 16,800	Value \$1,264	Pounds 3294	Pounds 705	Value \$633	Pounds 15,110	Pounds \$1,013	Value \$12	Pounds 60,818	Pounds 38,973	Value 1,025
February.....	31,705	16,800	1,263	3294	705	633	15,110	1,013	12	60,818	38,973	1,103
March.....	85,283	45,000	2,582	9033	2,000	1,588	27,056	2,535	44	50,924	1,872	3
April.....	984,155	531,498	23,459	55,285	1,000	1,190	312,905	2,265	29	309,918	4,128	45
May.....	1,421,370	745,100	34,765	83,864	1,864	842	315,550	3,959	463	107,411	1,400	2,230
June.....	1,523,370	810,118	40,767	93,654	2,000	1,000	315,550	3,959	463	107,411	1,400	2,230
July.....	1,421,370	745,100	34,765	83,864	1,864	842	315,550	3,959	463	107,411	1,400	2,230
August.....	368,317	14,218	6,703	18,218	285	1,000	285,898	3,854	42,851	175,922	2,843	1,135
September.....	1,068,015	23,725	15,211	1,945	10	5	892,015	13,460	518	107,240	1,709	845
October.....	1,423,718	23,725	15,211	1,945	10	5	892,015	13,460	518	107,240	1,709	845
November.....	368,540	4,775	107	15,530	210	8	164,005	3,236	473	337,747	8,892	4,559
December.....	6,935	500	19	17	107	17	351,817	14,732	520	205,901	4,559	1,734
Total.....	1,490	3,460	30	59	99	99	55,193	3,024	159	55,439	1,734	118
Total.....	6,276,223	78,000	108,097	353,058	4,274	9	2,921,172	55,061	2,783	19,284	619	1,060
LANDED AT PORTLAND.												
January.....	212,607	5,020	10,343	54,055	866	10	20,729	1,144	23	60,818	1,175	31
February.....	139,796	6,501	6,501	38,435	1,588	10	10,862	663	23	38,973	1,103	3
March.....	188,450	10,610	10,610	38,435	1,588	10	10,862	663	23	38,973	1,103	3
April.....	416,471	8,267	8,267	40,080	1,942	10	29,445	1,208	48	50,924	1,872	3
May.....	1,047,414	15,739	15,739	38,667	942	10	39,550	1,823	48	309,918	4,128	45
June.....	1,399,988	1,989	1,989	254,601	3,147	10	20,440	424	20	107,411	1,400	2,230
July.....	667,318	9,212	9,212	62,120	677	10	73,891	1,670	728	192,631	2,982	45
August.....	489,063	6,045	6,045	76,530	1,023	10	24,505	1,728	4	175,922	2,843	1,135
September.....	673,041	10,112	10,112	96,886	2,262	18	317,148	6,921	4	107,240	1,709	845
October.....	117,347	4,262	4,262	18,979	413	18	125,526	4,236	18	337,747	8,892	4,559
November.....	167,646	9,068	9,068	19,919	520	18	42,533	1,864	18	205,901	4,559	1,734
December.....	242,775	13,028	13,028	26,862	750	28	16,769	974	27	55,439	1,734	118
Total.....	4,481,916	108,226	108,226	708,814	11,278	28	732,688	21,414	528	1,802,103	36,266	5,450
Grand total.....	45,109,704	1,429,988	1,429,988	15,261,792	327,366	37	5,787,117	161,066	2,810	7,241,974	173,230	6,510

Grounds E. of 66° W. long Grounds W. of 66° W. long Landed at Boston in 1915 Landed at Gloucester in 1915	9,185,093 35,851,666 36,035,066 8,913,010	164,167 18,649 101,423 180,594	3,617 639 11,804,369 2,361	1,288,710 14,023,062 11,804,369 1,060,575	28,318 268,878 166,064 7,728	Cusk.				Halibut.				
						Pollock.		Cusk.		Halibut.		Halibut.		
						Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.	Fresh.	Salted.	
Month.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.														
January	94,398	\$2,956	172,689	\$4,225	335,009	7,321	10,935	\$3,702	36,785	7,104	103,043	16,398	136,985	16,024
February	90,355	3,560	335,009	7,321	869,445	14,088	2,902	27,880	48,159	9,390	253,905	27,880	165,766	16,815
March	91,364	4,199	363,943	10,654	470,311	7,568	211,714	21,206	103,043	16,398	136,985	16,024	123,107	13,287
April	163,495	4,054	869,445	14,088	133,628	2,902	243,033	6,329	165,766	16,815	161,178	4,009	11,105	2,840
May	217,788	4,284	470,311	7,568	200,067	4,154	205,279	5,526	123,107	13,287	1,141,955	144,128		
June	263,599	7,880	133,628	2,902	186,167	3,643			16,178	4,009				
July	398,584	12,678	200,067	4,154	178,889	3,906			16,178	4,009				
August	631,117	19,083	186,167	3,643	243,033	6,329			16,178	4,009				
September	726,832	18,692	178,889	3,906	299,069	7,386			16,178	4,009				
October	647,157	18,563	178,889	3,906	299,069	7,386			16,178	4,009				
November	277,223	7,404	243,033	6,329	299,069	7,386			16,178	4,009				
December	191,270	5,444	205,279	5,526	205,279	5,526			11,105	2,840				
Total	3,792,169	108,797	3,657,429	77,702	3,657,429	77,702			1,141,955	144,128				
LANDED AT GLOUCESTER.														
January	753,418	27,289	7,406	104	180	\$4	25,600	3,785	130,945	16,253	2,779	318,629	7,789	1,905
February	68,010	3,296	1,500	20	160	6	130,945	16,253	27,787	1,315	31	6,925,345	165,441	4,608
March	46,807	2,353	1,500	20	160	6	130,945	16,253	27,787	1,315	31	6,925,345	165,441	4,608
April	273,685	8,253	1,500	20	160	6	130,945	16,253	27,787	1,315	31	6,925,345	165,441	4,608
May	940,821	16,869	1,500	20	160	6	130,945	16,253	27,787	1,315	31	6,925,345	165,441	4,608
June	327,255	3,582	20,680	387	3,069	97	327,334	30,196	327,334	30,196	75	6,520,287	119,954	
July	51,431	532	20,680	387	3,069	97	327,334	30,196	327,334	30,196	75	6,520,287	119,954	
August	28,023	370	20,680	387	3,069	97	327,334	30,196	327,334	30,196	75	6,520,287	119,954	
September	59,730	885	20,680	387	3,069	97	327,334	30,196	327,334	30,196	75	6,520,287	119,954	
October	120,884	3,812	20,680	387	3,069	97	327,334	30,196	327,334	30,196	75	6,520,287	119,954	
November	3,753,668	77,589	20,680	387	3,069	97	327,334	30,196	327,334	30,196	75	6,520,287	119,954	
December	3,663,461	90,756	20,680	387	3,069	97	327,334	30,196	327,334	30,196	75	6,520,287	119,954	
Total	10,117,193	236,060	78,168	1,635	1,553,926	22,263	34,090	869	1,686,252	175,295	2,210	1,105	95,244	8,510

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN FISHING VESSELS DURING THE YEAR 1916, SHOWN BY MONTHS—Continued.

Month.	Follock.			Cusk.			Halibut.		
	Fresh.		Salted.	Fresh.		Salted.	Fresh.		Salted.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.
LANDED AT PORTLAND.									
January.....	55,532	\$1,448	.....	43,487	\$1,197	.....	11,421	\$1,628	.....
February.....	138,147	4,850	1,540	38,345	1,161	.....	24,877	2,958	.....
March.....	275,730	12,191	9,908	91,868	2,877	.....	58,078	6,612	.....
April.....	262,382	4,880	9,325	135,738	3,441	.....	62,214	8,259	.....
May.....	385,045	3,435	5	126,730	1,849	.....	80,055	6,431	.....
June.....	73,998	843	340	15,823	265	.....	43,470	4,826	.....
July.....	43,606	784	.....	37,124	824	.....	61,691	5,983	.....
August.....	23,695	528	.....	21,040	519	.....	85,204	8,709	.....
September.....	17,728	323	1,435	33,964	739	.....	52,766	5,552	.....
October.....	69,686	2,001	.....	129,036	3,106	.....	34,028	3,526	.....
November.....	127,061	2,527	260	83,205	2,003	.....	19,964	2,985	.....
December.....	130,515	2,862	.....	47,912	1,469	.....	1,516	193	.....
Total.....	1,593,125	36,721	22,975	805,172	18,450	17,770	535,314	57,662	.....
Grand total.....	15,502,487	381,578	101,143	6,016,527	118,415	51,770	3,363,521	377,075	95,244
Grounds E. of 66° W. long.....	370,344	7,058	43,848	1,412,399	22,924	25,421	2,414,202	253,348	8,484
Grounds W. of 66° W. long.....	15,132,143	374,520	57,295	4,604,128	95,491	26,349	949,319	123,737	315
Landed at Boston in 1915.....	4,284,417	103,733	.....	3,321,681	53,127	.....	930,408	103,327	26
Landed at Gloucester in 1915.....	8,676,866	145,455	234,640	2,914,120	42,876	94,943	2,653,766	199,460	21,509
Mackerel.									
Month.	Large (over 2½ pounds).			Medium (1½ to 2½ pounds).			Small (under 1½ pounds).		
	Fresh.		Salted.	Fresh.		Salted.	Fresh.		Salted.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.
LANDED AT BOSTON.									
May.....	840	\$235	.....	603	\$151	.....	286,047	\$10,299	.....
June.....	1,032,091	48,554	.....	231,814	9,591	.....	300,587	12,023	.....
July.....	756,241	34,651	20,000	272,924	11,408	9,400	.....	.....	.....

August.....	1,320,515	101,880	.....	280,052	16,944	.....	170,199	11,514	.....
September.....	989,178	56,940	.....	304,533	16,582	.....	1,630	.....	.....
October.....	727,455	57,763	.....	904,224	70,262	.....	3,456	8,600	8,600
November.....	416,072	27,851	.....	326,245	21,431	.....	.....	.....	.....
Total.....	5,191,392	327,874	20,000	2,341,095	146,569	47,800	4,161	891,065	42,370
LANDED AT GLOUCESTER.									
May.....	22,390	.....	600	.....	.....	.....	.....	1,400	49
June.....	56,803	2,831	466,000	32,101	33	.....	.....	79,280	2,976
July.....	28,430	8,275	109,800	8,794	.....	126,800	8,560	772,555	54,404
August.....	212,833	8,235	319,200	31,822	106,135	322,913	28,370	8,413	2,373
September.....	24,280	1,497	945,006	58,754	545,049	1,204,843	116,022	5,175	34,860
October.....	.....	.....	252,400	17,132	207,422	567,373	50,942	2,167	43,000
November.....	.....	.....	.....	.....	18,536	13,200	1,294	5,988	3,906
Total.....	344,838	14,518	1,823,066	148,126	880,162	2,235,131	203,178	18,339	831,695
LANDED AT PORTLAND.									
June.....	2,062	125	.....	.....	.....	.....	.....	.....	.....
July.....	6,896	565	.....	.....	.....	.....	.....	.....	.....
August.....	174,294	8,670	20,880	.....	.....	.....	.....	150	.....
September.....	28,875	2,182	171,354	.....	.....	1,055	108	3,540	.....
October.....	955	124	21,770	.....	.....	.....	.....	1,283	.....
November.....	.....	.....	.....	.....	.....	.....	.....	10,794	258
Total.....	213,873	11,792	.....	.....	.....	.....	.....	7,370	.....
Grand total.....	5,750,103	354,184	1,943,066	149,476	1,055	2,283,986	207,447	15,767	847,666
Grounds E. of 69° W. long.									
Grounds W. of 66° W. long.	874,454	40,821	522,800	35,924	6,872	118,200	7,977	29,500	.....
Landed at Boston in 1916.....	4,875,649	313,363	1,320,266	113,552	490,007	2,165,786	199,470	1,613,647	64,826
Landed at Gloucester in 1915.....	638,888	69,851	145,988	6,835	73,715	35,596	4,987	185,782	11,049
.....	56,125	3,870	896,200	41,534	6,797	67,700	5,012	67,001	2,140,421
.....	.....	.....	.....	.....	.....	.....	.....	.....	161,646



QUANTITIES AND VALUES OF CERTAIN FIBREY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN  
FISHING VESSELS DURING THE YEAR 1916, SHOWN BY MONTHS—Continued.

Month.	Miscellaneous.				Total.		Grand total.	
	Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.								
January.....	248,563	\$5,092			5,280,841	\$204,863	5,280,841	\$204,863
February.....	715,017	25,515			7,411,008	255,960	7,411,008	255,960
March.....	85,210	5,242			6,410,470	313,101	6,410,470	313,101
April.....	115,824	2,974			9,300,268	221,750	9,300,268	221,750
May.....	317,278	6,016			8,274,376	201,717	8,274,376	201,717
June.....	466,699	11,535			8,895,789	303,375	8,895,789	303,375
July.....	1,360,675	113,066			9,406,060	376,977	9,415,460	377,702
August.....	1,250,249	106,570			11,402,268	487,116	11,402,268	487,116
September.....	817,032	47,257			10,244,309	357,787	10,252,709	361,243
October.....	467,771	19,347			9,471,726	426,218	9,480,326	427,078
November.....	651,640	21,314			6,892,701	284,241	6,892,701	284,241
December.....	237,525	10,402			5,310,792	252,909	5,310,792	252,909
Total.....	6,712,473	375,220			98,254,638	3,063,994	98,331,038	3,702,305
LANDED AT GLOUCESTER.								
January.....	1,726,111	65,484			2,790,595	104,242	2,790,595	216,424
February.....	1,402,000	49,105			1,853,465	77,265	2,787,953	101,540
March.....	312,500	3,638			637,890	33,314	1,006,785	43,620
April.....	20,000	250			3,629,772	124,004	3,785,613	130,572
May.....	812,330	8,357			7,679,740	102,913	7,785,845	172,117
June.....	596,360	5,900			4,861,178	102,913	7,604,028	244,121
July.....	432,225	2,710			3,896,685	95,409	6,966,907	263,111
August.....	594,196	3,373			5,500,100	126,392	8,330,163	330,181
September.....	945,021	5,805			4,874,733	103,917	6,892,068	252,483
October.....	472,921	3,760			2,265,968	83,163	3,290,630	107,867
November.....	257,919	11,291			4,670,960	117,760	5,191,309	145,615
December.....					3,862,133	96,732	5,564,701	152,243
Total.....	7,318,563	160,173			46,515,277	1,212,013	66,680,546	2,169,894
LANDED AT PORTLAND.								
January.....	5,108	54			676,490	26,544	683,596	26,981
February.....	11,115	126			676,878	29,358	676,878	29,358
March.....	83,391	870			1,284,890	42,453	1,284,890	42,453
April.....	11,061	221			2,586,811	54,976	2,586,811	54,976
May.....	1,066,108	10,376			4,662,518	49,718	4,662,518	49,718
June.....	3,966,313	34,481			4,662,518	49,718	4,662,518	49,718

July.....	494,500	8,257	.....	1,810,901	37,923	340	12	1,811,331	37,035
August.....	228,252	6,267	.....	1,209,360	30,457	6,000	167	1,215,450	30,624
September.....	124,328	3,674	.....	2,044,574	61,438	159,030	4,676	2,203,604	66,133
October.....	112,412	2,804	.....	1,142,597	44,494	6,832	208	1,148,470	44,702
November.....	58,441	2,202	.....	902,755	36,744	3,520	37	906,275	36,781
December.....	42,310	2,000	.....	848,216	34,974	3,386	7	848,601	34,981
Total.....	6,182,411	71,421	40	20,551,394	513,071	261,445	7,976	20,812,839	521,647
Grand total.....	20,213,467	606,824	183,346	165,321,309	5,421,078	20,503,116	902,228	185,824,425	6,383,906
Grounds E. of 66° W. long.....	4,286,532	167,750	183,344	36,008,367	1,155,535	15,356,905	552,319	51,365,332	1,707,904
Grounds W. of 66° W. long.....	15,926,915	438,074	2	129,312,942	4,265,093	5,146,151	409,909	134,459,093	4,676,002
Landed at Boston in 1915.....	5,809,344	314,113	.....	97,397,285	2,883,354	502,202	22,060	97,899,487	2,911,314
Landed at Gloucester in 1915.....	4,649,569	84,732	8,031,550	49,677,980	1,012,279	24,015,261	814,324	73,696,241	1,836,603

\* Includes herring from Newfoundland, 4,046,011 pounds frozen, value, \$142,669, and 7,223,224 pounds salted, value, \$133,344.

The principal source of supply for the large quantities of fish landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., is the fishing grounds lying off the coast of the United States. In the calendar year 1916, 72.10 per cent of the quantity and 72.96 per cent of the value of the catch landed by the American fishing fleet at these three ports were taken from these grounds. Of the remainder, 9.06 per cent of the quantity and 9.34 per cent of the value were taken from fishing banks off the coast of Newfoundland, 18.80 per cent of the quantity and 17.61 per cent of the value from grounds off the Canadian Provinces, and less than 1 per cent of both the quantity and value from the coast of Labrador. Herring from Newfoundland constituted 6.06 per cent of the quantity and 5.10 per cent of the value of the fishery products landed at these ports during the year. The herring were taken on the treaty coasts of Newfoundland, but cod and other species from that region were obtained chiefly from fishing banks on the high seas. All fish caught by American fishing vessels off the Canadian Provinces were from offshore fishing grounds. The catch for each of these regions is given in detail in the following table:

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., IN 1916, FROM GROUNDS OFF THE COAST OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

Species.	United States.		Newfoundland. <sup>a</sup>		Canadian Provinces.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Cod:								
Fresh.....	22,358,873	\$869,105	827,672	\$21,114	12,806,544	\$328,350	35,993,089	\$1,218,569
Salted.....	603,249	29,724	3,021,449	120,726	4,004,775	178,863	7,629,473	338,313
Haddock:								
Fresh.....	49,843,838	1,488,572	105,265	1,504	10,422,393	267,306	60,371,496	1,757,382
Salted.....	19,829	668	110,639	2,534	53,828	1,091	184,296	4,293
Hake:								
Fresh.....	10,520,206	287,772	265,974	4,403	2,242,911	42,121	13,029,091	334,296
Salted.....	5,356	130	64,290	1,349	73,562	1,465	143,208	2,944
Pollock:								
Fresh.....	15,125,113	374,361	5,350	73	372,094	7,144	15,502,487	381,578
Salted.....	57,295	1,133	17,840	388	26,008	517	101,143	2,038
Cusk:								
Fresh.....	4,428,815	92,539	51,765	860	1,535,947	25,016	6,016,527	118,415
Salted.....	26,349	878	7,545	175	17,876	482	51,770	1,035
Halibut:								
Fresh.....	896,724	117,509	1,084,749	107,110	1,382,048	152,456	3,363,521	377,075
Salted.....	315	26	66,649	6,212	28,280	2,272	95,244	8,510
Mackerel:								
Fresh.....	9,740,800	579,076	.....	.....	1,090,831	48,463	10,831,631	627,539
Salted.....	4,433,718	377,848	.....	.....	641,000	43,901	5,074,718	421,749
Herring:								
Fresh.....	7,360,705	66,641	4,049,011	142,659	300	5	11,410,016	209,305
Salted.....	.....	.....	7,223,224	183,344	.....	.....	7,223,224	183,344
Swordfish:								
Fresh.....	1,647,908	217,867	735	74	123,669	20,338	1,772,312	238,279
Tilefish:								
Fresh.....	873,142	24,295	.....	.....	.....	.....	873,142	24,295
Miscellaneous:								
Fresh.....	6,042,215	130,220	360	22	115,422	4,703	6,157,997	134,945
Salted.....	40	2	.....	.....	.....	.....	40	2
Total.....	133,984,490	4,657,866	16,902,517	601,547	34,937,418	1,124,493	185,824,425	6,383,906

<sup>a</sup> Includes 13,210 pounds of salted cod, valued at \$576, and 42,975 pounds of salted halibut, valued at \$4,449, from the Labrador coast.

*Cod.*—In 1916 there were 19 vessels employed in the salt bank fishery and 96 in the market fishery landing their fares at Boston, Gloucester, and Portland. Considerable quantities of cod were brought in also by vessels operating on the shore grounds. The total

quantity of cod landed was 43,622,562 pounds, valued at \$1,556,882, of which 35,993,089 pounds, valued at \$1,218,569 were fresh, and 7,629,473 pounds, valued at \$338,313, were salted.

*Haddock.*—The haddock is the most important of the fishes taken in these fisheries. The quantity landed was 60,555,792 pounds, valued at \$1,761,675, nearly all in a fresh condition, only 184,296 pounds, valued at \$4,293, being salted.

*Hake.*—The year's yield of hake amounted to 13,172,299 pounds, valued at \$337,240. The entire catch was landed fresh with the exception of 143,208 pounds, valued at \$2,944, which were salted.

*Pollock.*—The pollock fishery was in a prosperous condition in 1916, and the catch landed at Boston and Gloucester exceeded that of the previous year by 791,577 pounds in quantity and \$93,234 in value. The total yield for Boston, Gloucester, and Portland was 15,603,630 pounds, valued at \$383,616. This quantity was landed fresh except 101,143 pounds, valued at \$2,038, which were salted.

*Cusk.*—The catch of cusk was 6,068,297 pounds, valued at \$119,450, of which 51,770 pounds, valued at \$1,035, were salted.

*Halibut.*—The halibut fishery on the Atlantic has varied but little during the past few years. The catch in 1916 was 3,458,765 pounds, valued at \$385,585, all of which was landed fresh except 95,244 pounds, valued at \$8,510, salted. The quantity landed at Boston and Gloucester declined from 3,870,685 pounds in 1915 to 2,923,451 pounds in 1916, but in the latter year there was an increase of \$4,627 in the value.

*Mackerel.*—There is reason to believe that the abundance of mackerel is increasing, and there is no reason why the large catches of former years may not be repeated. The yield of fresh mackerel by the American fleet in 1916 was 102,420 barrels, compared with 71,564 barrels the previous year, an increase of 30,856 barrels. The output of salted mackerel was 19,554 barrels, compared with 19,691 barrels the previous year, a decrease of 137 barrels. The quantity landed at Boston, Gloucester, and Portland during the year was 15,906,349 pounds, valued at \$1,049,288, of which 10,831,631 pounds, valued at \$627,539, were fresh, and 5,074,718 pounds, valued at \$421,749, were salted.

In 1917 up to June 30 the catch of fresh mackerel was 38,947 barrels and of salted mackerel 7,131 barrels, as against 43,169 barrels fresh and 4,468 barrels salted for the previous year to the same date. The mackerel fishery in the spring of 1917 was interrupted owing to a strike among the fishermen at the beginning of the season. The seining fleet was delayed in sailing, and the season was a failure so far as the seiners were concerned. The gill netters had a very successful season, and the fishermen made the largest shares for many years. During the season of six weeks some of the fishermen shared \$1,000 each, and a considerable number shared \$500 each. The fleet numbered about 30 sail of seiners in the south and about 125 sail of netters, about the same number as in the previous season. The fish taken were of mixed sizes, weighing from about 1½ to 3½ pounds each, and brought from 8 to 14 cents a pound, according to market conditions. Up to the latter part of May the catch was only about one-third that of the previous season. The first fare of mackerel of the season of 1917, amounting to 5 barrels, was landed

April 25 at Atlantic City, N. J.; these fish weighed  $1\frac{1}{2}$  pounds each and sold in New York at 22 cents a pound. The Cape Shore fleet numbered about 32 sail, or about 8 more than in the previous year. These vessels were very successful, and more vessels than ever before made second trips, and one vessel made three trips.

*Swordfish.*—The catch of swordfish landed at Boston, Gloucester, and Portland amounted to 1,772,312 pounds, valued at \$238,279. The swordfish fleet was not so large as in the previous year, and the receipts at Boston and Gloucester declined 483,345 pounds in quantity but increased \$14,743 in value.

#### FISHERIES OF THE PACIFIC COAST STATES.

The Bureau has completed a canvass of the commercial fisheries of the Pacific Coast States for the calendar year 1915, and a bulletin embodying the results of the canvass has been prepared for distribution to the trade. The statistical agents of the Bureau visited every fishing community and obtained data by personal interviews with fishermen and fish handlers and by personal examination of all available records. The last general canvass of the fisheries of this region was made by the Bureau for 1904.

The number of persons engaged in the fisheries of these States was found to be 28,936; the investment in vessels, boats, fishing apparatus, shore and accessory property, and cash capital amounted to \$24,025,172; and the products aggregated 286,204,558 pounds, with a value to the fishermen of \$9,300,672. Washington ranks first among these States in the extent of its fisheries. In 1915, this State had 14,609 persons employed, an investment of \$14,133,908, and products amounting to 158,983,478 pounds, valued at \$5,317,080. California ranked second with 8,457 persons employed, an investment of \$5,827,113, and products of 92,513,457 pounds, valued at \$2,488,098. In Oregon the number of persons employed was 5,870, the investment \$4,064,151, and the products aggregated 34,707,623 pounds, valued at \$1,495,494.

The pack of canned salmon in the three States aggregated 1,961,026 cases, valued at \$9,298,566; the pack of canned tuna, all of which is put up in California, aggregated 258,427 cases, valued at \$1,517,858, and other canned articles amounted in value to \$858,907; a total of \$11,675,331.

The species taken in largest quantities were albacore or tuna, 21,049,190 pounds, valued at \$316,103; cod, 10,487,401 pounds, valued at \$343,338; halibut, 40,825,874 pounds, valued at \$2,050,709; and salmon, 131,128,934 pounds, valued at \$4,089,865.

Compared with the returns for 1904, there has been a very large increase in the fisheries of these States. The number of persons employed has increased 9,278, or 47.19 per cent; the investment \$11,185,223, or 87.11 per cent; and the output 117,604,882 pounds, or 69.75 per cent, in quantity, and \$2,619,806, or 39.21 per cent, in value. Statistics of the fisheries, including the quantity and value of canned products, of the Pacific Coast States in 1915, and comparative statistics of products for various years from 1888 to 1915, are given in the following tables:



STATISTICS OF THE FISHERIES OF THE PACIFIC COAST STATES IN 1915—Continued.  
FRESH AND SALTED PRODUCTS, ETC.

	Washington.		Oregon.		California.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Albacore (or tuna):								
Fresh.					21,024,190	\$315,622	21,024,190	\$315,622
Salted.					26,000	461	26,000	461
Anchovies:								
Fresh.					81,388	1,730	81,388	1,730
Salted.					16,000	1,600	16,000	1,600
Barracuda:								
Fresh.					3,262,646	111,660	3,262,646	111,660
Salted.					13,180	13,180	330,000	13,180
Bonito.					448,256	12,622	448,256	12,622
Carp.					350,815	6,366	600,815	11,116
Catfish.	200,000	\$4,000	50,000	\$750	517,054	24,299	517,054	24,299
Cod:								
Fresh.	22,025	421	14,400	288			36,425	709
Salted.	5,498,284	180,974			4,952,692	161,693	10,450,976	342,629
Croakers.					3,150	65	3,150	65
Flounders:								
Fresh.	28,285	586	1,965	40	6,914,003	206,291	6,939,283	209,917
Salted.					9,500	475	9,500	475
Grayfish.							7,083,996	15,959
Hake:								
Fresh.					221,252	1,937	221,252	1,937
Salted.					24,000	980	24,000	980
Halibut.							40,825,874	2,040,709
Hardhead.							73,423	3,622
Herring.								
Fresh.	2,129,149	9,655	12,500	383	764,384	7,116	2,906,073	17,154
Salted.					50,000	1,000	50,000	1,000
Jewishfish:								
Fresh.					116,461	1,859	116,461	1,859
Salted.					138,000	6,020	138,000	6,020
Kingfish.					666,003	17,362	666,003	17,362
"Lingcod":								
Fresh.					570,860	14,687	1,420,840	17,893
Salted.	837,110	2,812	12,870	384	3,500	175	3,500	175
Mackerel:								
Fresh.					253,899	6,668	253,899	6,668
Salted.					6,450	259	6,450	259
Mullet.					300	300	3,000	300
Perch.					216,783	6,037	243,465	6,910
Pike, Sacramento.	14,750	483	11,630	360			15,884	449
Pompano.					19,350	2,032	19,350	2,032

[illegible]

• Taken in Columbia River by California fishermen.

Includes 5,131 pounds of yellowfin, valued at \$145.



STATISTICS OF THE FISHERIES OF THE PACIFIC COAST STATES IN 1915—Continued.  
FRESH AND SALTED PRODUCTS, ETC.—Continued.

	Washington.		Oregon.		California.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Clams:								
Hard	175,744	\$12,191			68,586	\$17,583	244,330	\$29,774
Soft	1,200	150	22,460	\$3,041	67,160	18,107	69,360	21,253
Razor	372,750	56,446	77,200	10,900			449,950	67,346
Mussels	700	83			19,240	2,326	19,940	2,409
Oysters:								
Eastern, market.	265,013	140,028			375,774	165,573	640,787	305,601
Native:								
Market.	450,394	260,268	1,547	725			451,941	261,000
Seed.	24,808	58,619			8,435	6,513	33,243	65,132
Octopus.					32,309	2,717	32,309	2,717
Squid.	15,000	325			6,211,325	32,026	6,226,325	32,741
Crabs.	1,734,410	54,536	415,772	13,755	1,414,155	128,434	3,148,587	166,185
Crawfish.			183,720	20,747			183,720	20,747
Spiny lobsters.					892,392	130,119	892,392	130,119
Shrimp.	386,420	18,719			286,000	5,550	672,420	24,269
Turtle.					206	13	206	13
Whale oil.	2,685,125	112,851					2,685,125	112,851
Whalebone.	6,000	4,200					6,000	4,200
Other whale products.	1,292,000	24,390					1,292,000	24,390
Sea lion.					9,375	4,120	9,375	4,120
Kelp.	450,000	191			5,000,000	2,600	5,450,000	2,791
Other seaweeds.					6,799	325	6,799	325
Total.	158,983,478	5,317,080	34,707,623	1,465,464	92,513,457	2,488,098	286,204,558	9,300,672

COMPARATIVE YIELD OF FRESH AND SALTED PRODUCTS IN YEARS SPECIFIED.*					
Year.	Pounds.	Value.	Pounds.	Value.	Pounds.
1888.	23,400,292	\$380,800	23,313,324	\$1,001,943	71,893,882
1892.	36,757,257	931,568	57,838,466	3,022,001	128,116,886
1895.	59,079,527	1,401,433	50,010,020	1,796,483	147,231,179
1899.	121,684,908	2,894,908	74,462,089	2,568,383	219,337,816
1904.	88,984,700	2,973,633	52,109,654	2,523,141	168,599,676
1908.	100,446,000	3,513,000	47,477,000	1,970,000	176,170,000
1915.	158,983,478	5,317,080	92,513,457	2,488,098	286,204,558

## MOLLUSKS AND WHALE OIL, IN BUSHELS AND GALLONS.

Clams:	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Hard.....	21,563	\$12,191	.....	.....	.....	.....	.....	.....
Soft.....	120	56,448	.....	.....	.....	.....	.....	.....
Bay.....	37,276	140,028	.....	.....	.....	.....	.....	.....
Oysters:	.....	.....	.....	.....	.....	.....	.....	.....
Eastern, market.....	37,859	140,028	.....	.....	.....	.....	.....	.....
Native.....	.....	.....	.....	.....	.....	.....	.....	.....
Market.....	64,342	250,298	.....	.....	.....	.....	.....	.....
Seed.....	3,544	8,619	.....	.....	.....	.....	.....	.....
Mussels.....	70	83	.....	.....	.....	.....	.....	.....
Whale oil.....	351,350	112,851	.....	.....	.....	.....	.....	.....
Total.....	.....	.....	.....	.....	.....	.....	.....	.....

CANNED PRODUCTS.<sup>a</sup>

Albacore (tuna).....	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Bonito.....	.....	.....	.....	.....	.....	.....	.....	.....
Salmon:	.....	.....	.....	.....	.....	.....	.....	.....
Blueback.....	91,720	\$632,394	.....	.....	.....	.....	.....	.....
Chinook.....	178,464	1,400,220	.....	.....	.....	.....	.....	.....
Chum.....	450,409	1,219,061	.....	.....	.....	.....	.....	.....
Humpback.....	560,378	1,772,565	.....	.....	.....	.....	.....	.....
Silver.....	206,508	1,036,559	.....	.....	.....	.....	.....	.....
Steelhead.....	10,270	64,890	.....	.....	.....	.....	.....	.....
Yellowtail.....	.....	.....	.....	.....	.....	.....	.....	.....
Clams:	.....	.....	.....	.....	.....	.....	.....	.....
Not cooked.....	49,337	211,008	.....	.....	.....	.....	.....	.....
Clam juice.....	7,505	4,066	.....	.....	.....	.....	.....	.....
Not cooked.....	270	1,050	.....	.....	.....	.....	.....	.....
Oysters, not cooked.....	4,944	2,427	.....	.....	.....	.....	.....	.....
Miscellaneous.....	46,103	120,513	.....	.....	.....	.....	.....	.....
Total.....	.....	6,765,023	.....	.....	.....	.....	.....	.....

<sup>a</sup> Includes 640 pounds of cookies, valued at \$164.<sup>b</sup> Value estimated.<sup>c</sup> The statistics for 1908 in this table are from data published by the Bureau of the Census.<sup>d</sup> All products except clams and clam juice, which have no uniform weight, represent 48 pounds to the case.<sup>e</sup> Includes 553 cases smoked before canning.<sup>f</sup> Includes 656 cases smoked before canning.<sup>g</sup> Includes shad, 9,906 cases, valued at \$29,576; shad roe, 6,563 cases, valued at \$80,302; and 49,170 cases sardines, abalone, crabs, rockfish, and mussels, valued at \$265,596.

## VESSEL FISHERIES AT SEATTLE, WASH.

Statistics of the vessel fisheries at Seattle, Wash., have been collected by the local agent and published as monthly and annual bulletins giving the quantity and value of fishery products landed by American fishing vessels at that port.

In 1916 there were landed at Seattle by American fishing vessels 517 trips aggregating 17,411,435 pounds of fish, having a value to the fishermen of \$1,361,233. These fish were taken from the fishing grounds along the coast from off the Columbia River northward to Portlock Bank, Alaska. The products included 15,317,992 pounds of halibut, valued at \$1,306,645; 2,039,200 pounds of sablefish, or black cod, valued at \$53,438; and 54,243 pounds of other species, valued at \$1,150.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels amounted to 10,137,387 pounds, valued at \$471,259. These products included 8,141,682 pounds of salmon, valued at \$427,812; 1,425,989 pounds of herring, valued at \$9,028; 149,214 pounds of steelhead, valued at \$12,405; 61,957 pounds of salmon trout, valued at \$5,201; 41,274 pounds of smelt, valued at \$2,130; 59,487 pounds of flounders, valued at \$1,025; 47,071 pounds of sole, valued at \$1,164; 127,388 pounds of crabs, valued at \$8,890; and a number of other species in smaller quantities. The quantity and value of fishery products landed at Seattle by fishing and collecting vessels in 1916 are given in detail in the following tables:

QUANTITIES AND VALUES OF CERTAIN FRESH FISHERY PRODUCTS LANDED AT SEATTLE, WASH., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1916.  
BY FISHING GROUNDS.

	Num-ber of trips.	Hullbut.		Cod.	Sablefish (black cod).		"Lingcod."		Red rockfish.		Total.
		Pounds.	Value.		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Columbia River grounds.....	28	985,662	\$86,666		174,265	\$4,073	3,455	\$69			\$80,798
Grays Harbor grounds.....	19	477,000	42,703		547,955	15,884					1,164,402
Flattery Banks.....	254	2,773,628	241,956	60	878,117	22,960	3,158	59	14,943	\$349	1,024,955
West coast, Vancouver Island.....	24	474,000	50,441		65,000	1,700					3,699,806
Hecate Strait.....	91	2,912,513	259,131		140,490	3,623	8,113	142	6,565	132	539,000
Forrester Island.....	2	61,894	6,381		15,286	382			1,342	27	3,067,621
Coronation Island.....	16	334,063	33,063								78,432
Cape Oomaney.....	3	165,079	10,607		17,371	444	1,530	30	3,117	70	324,003
Cape Spencer.....	1	10,000	1,250								187,697
Fairweather grounds.....	4	266,786	22,758		1,350	29					10,000
Yakutat grounds.....	61	4,185,538	341,730		127,551	2,819	305	6	2,400	80	288,186
Yakutat grounds.....	1	136,077	10,908								4,315,789
Middleton Island grounds.....	3	363,225	22,626								136,077
Portlock Bank.....	20	2,181,052	177,235	324	6	71,885	8,900	178	131	1	363,225
Total.....	517	15,317,992	1,306,945	384	7	2,039,200	53,438	25,461	494	659	17,411,435

## BY MONTHS.

	Num-ber of trips.	Hullbut.		Cod.	Sablefish (black cod).		"Lingcod."		Red rockfish.		Total.
		Pounds.	Value.		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
January.....	8	923,055	\$68,049		18,000	\$390					941,055
February.....	7	705,831	47,669		16,232	443					723,163
March.....	31	815,206	82,226		16,175	484					831,444
April.....	1	207,072	130,438	60							1,235,357
May.....	80	2,024,105	129,672		84,966	2,124	6,006	\$120	11,413	\$263	2,109,060
June.....	78	1,714,712	150,893		200,233	4,883	11,732	230	5,990	123	1,832,667
July.....	59	1,787,356	145,804		119,910	3,084	6,748	115	9,565	207	1,923,581
August.....	41	1,394,396	106,509	324	109,100	2,737	6,770	13	1,430	36	1,506,919
September.....	61	2,132,720	187,142		662,740	19,246	305	6			2,796,775
October.....	51	1,327,948	129,325		704,000	17,682					2,031,948
November.....	17	711,667	74,101		66,024	1,363					777,691
December.....	14	571,510	54,317		31,265	1,702					602,775
Total.....	517	15,317,992	1,306,945	384	7	2,039,200	53,438	25,461	494	659	17,411,435

## FISHERY PRODUCTS, BY MONTHS, TAKEN IN PUGET SOUND AND LANDED AT SEATTLE, WASH., BY COLLECTING VESSELS DURING 1916.

Species.	January.		February.		March.		April.		May.		June.		July.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sturgeon.....	34,200	\$171	169,900	\$751	784,600	\$5,737	11,170	1,117	198,780	14,664	561,544	42,116	698,883	41,333
Herring.....	4,000	200					493	49	16,742	1,296	26,576	1,993	28,665	1,720
Salmon:														
Chum or keta.....														
King or spring.....														
Coho or silver.....														
Sockeye or red.....														
Trout:														
Steelhead.....	16,962	1,557	14,011	1,243	4,311	366	17,400	1,740	34,022	2,730	17,698	1,416	7,675	461
Salmon.....							6,070	496	18,182	1,548	5,280	529	6,130	613
Perch.....	350	10	59	2			2,000	100	860	26	2,355	48	3,680	110
Red rockfish.....											675	14	545	12
Lingcod.....			275	3					1,492	19	500	10	450	9
Tomcod.....							1,400	35			13,064	199	13,060	261
Founders.....	784	12	512	7	850	17	1,800	45	9,382	164	5,535	137	6,270	187
Sole.....					1,060	32	2,400	72	7,450	186	2,075	104	5,200	208
Other fish.....			614	8							24,310	1,657		
Crabs.....	3,384	338	9,240	462	26,456	2,070	36,390	2,617	25,608	1,746				
Shrimp.....									1,800	180	4,500	450		
Total.....	59,680	2,288	194,611	2,476	787,277	8,222	91,123	6,311	767,013	24,826	711,979	52,027	798,851	47,150

Species.	August.		September.		October.		November.		December.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sturgeon.....	2,104	\$105									13,491	\$702
Herring.....	2,000	20									1,426,889	9,028
Salmon:												
Humpback or pink.....	3,000	65									3,000	65
Chum or keta.....	127,340	5,094	163,200	11,424	2,035,613	61,068	746,000	\$33,570	502,760	\$27,662	3,578,913	139,008
King or spring.....	753,142	45,199	428,870	30,020	1,733	1,733	34,450	2,067	6,500	488	2,714,813	178,717
Coho or silver.....	156,099	8,905	481,490	33,704	905,260	46,789	126,000	7,115		23	1,750,267	104,742
Sockeye or red.....	22,235	222									94,711	5,280
Trout:												
Steelhead.....	7,969	489	6,200	434	1,025	98	4,500	270	16,850	1,601	149,214	12,405
Salmon.....	15,110	907	7,840	784	1,106	111	2,200	223			61,957	5,201
Perch.....	8,240	347	13,950	837	8,755	523	3,000	180	5,000	150	41,274	2,130
Red rockfish.....	1,969	59	3,430	137	1,745	70					16,249	458
Lingcod.....	4,470	224	8,905	485	1,480	74	1,575	78	2,000	100	19,350	987
Total.....	833	18	1,460	29					10,000	150	15,002	238

Gabedian (black cod)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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## PRESERVATION AND UTILIZATION OF FISHERY PRODUCTS.

One of the most important services the Bureau can render is to send trained experts to the fishing centers to instruct those desirous of preserving fish by methods new to them, to ascertain by experiment the adaptability of various fishery products to untried methods of preservation of these products, to increase the utilization of waste fish and fish waste, to encourage the adoption of methods which will improve the character of the pack and discourage the use of methods which produce an unsatisfactory pack, to study and attempt to solve obstructive difficulties with which the fishermen are contending, to furnish advice relative to equipment needed and information as to where it may be obtained; in fact, to serve as efficiency experts to the fishery interests.

Although handicapped by lack of adequate provision for work of this character and inability to employ men with the desired basic training because of lack of funds, it has rendered important service to cannery men and others connected with the fisheries in the Middle Atlantic and New England States. There is a pressing demand for work of similar character in the South Atlantic and Gulf States, in the Pacific Coast States, and in the Great Lakes and Mississippi Valley region.

The diversion of some of the menhaden vessels to Government use, thereby diminishing the size of the fleet engaged in catching menhaden for fertilizer; the diversion of large amounts of tankage from the packing houses for hog feed, thereby reducing the sources of supply of ammoniates; the general scarcity of fertilizing materials; and the costliness of feed for poultry and stock, afford a very unusual opportunity for increasing the utilization of fish offal into oil, fertilizer, and fish meal. The amount of unutilized offal is very great. The Bureau has urged the fishermen to install conversion machinery and use this waste, in order to alleviate the shortages of oil, scrap, and meal, and has furnished information relative to machinery needed, etc.

Experiments have been made in the preservation of drum, sea robin, sharks, whiting, menhaden, river herring, bowfin, the milt roe of fishes, and various other neglected or little utilized products by untried methods of preservation, to ascertain the methods best adapted to the preservation of those products for market.

The methods of smoking and cooking smoked fresh-water fishes of various species have been described in circulars prepared and published for wide distribution. Active campaigns of demonstration and instruction were begun before the close of the fiscal year, with the promise of immediate practical results in the increased utilization of the "coarse" fishes.

## CURING ALEWIVES IN THE CHESAPEAKE BASIN.

Coincident with the decreased run of alewives, or river herring, in Chesapeake Bay and tributaries, the value of the fish has increased markedly. The methods of preserving the catch are, however, very wasteful. This is due in part to uneconomical methods of cutting the fish, to the custom of selling the fish by count instead of by weight, to the failure to fully utilize the roe, to lack of knowledge of

proper methods for canning the fish, and to failure to utilize the milt roe for food and more of the fish offal for fertilizer. At present the fish are marketed fresh, smoked, salted, and canned. Some of the roe is canned. The pickled fish are usually prepared in one of three ways, known as "cut" fish, "gross," and "selected roes."

The Bureau has recently been making a study of the industry in this region for the purpose of securing closer cooperation among the fishery interests so as to improve conditions, to give new methods of preserving the various products a trial, and to develop uses and markets for neglected products. By way of experiment, some of the fish were cured after the Scotch method and some of the milt roe was canned. From an analysis of the latter and tests as to the methods of preparation for the table, it appears that this will make a good food product.

The following method of canning alewives has proved quite satisfactory. The fish are cut, washed, and placed in the salting vats in the same manner as if intended for salt curing. After 12 to 14 hours they are removed from the vats and washed in an abundance of luke-warm fresh water. During the washing, they are trimmed, the balance of the fins and scales being removed. They are then cut to can size and placed in the cans, after which they are processed for 55 minutes at 244° F. for No. 1 cans and 60 minutes for No. 2 cans.

Herring roe intended for canning is collected in buckets as the fish are cut and washed in fresh water in special trays, blood and adhering particles of entrails being removed. The roe is then put in the cans. As it swells considerably in processing, the cans must not be entirely filled. If of the sanitary type, the cans are filled to within about three-fourths of an inch of the top with roe and then filled to the edge with cold salt brine, about 1 pound of salt to 8 or 10 gallons of water being used to make the brine. The brine is added solely for seasoning. The cans are immediately capped and placed in the processing baskets. If solder-top cans are used, the filled cans are placed in the exhaust box. Upon removal from the exhaust, the necessary air space is provided for by pressing the roe down with a plunger. Material clinging to the groove where the solder is to be applied is removed with a brush and the cans are capped and tipped. The canned roe is processed in a closed kettle for 45 to 55 minutes at a temperature of 240 to 245° F. The milt roe may be canned in the same manner as the roe except that the cans can be more completely filled, as this product does not swell in processing. As the quantity of brine used in this case will be somewhat less, it should be made correspondingly stronger.

#### EXPLOITATION OF NEGLECTED AQUATIC FOODS.

The Bureau has continued its active campaign in behalf of neglected products, more particularly those suitable for food, and has scored further successes in this important field.

The history of the establishment of the tilefish fishery was referred to at length in the last annual report, in which it was shown that to the end of the fiscal year 1916, when the fishery had been in existence only 8 months, there had been caught over 4,388,500 pounds of tilefish, for which the fishermen received more than \$210,000. By



the end of the first 12 months, the known catch was upward of 10,250,000 pounds, valued at more than \$400,000. During the fiscal year 1917, the landings aggregated 11,641,500 pounds, and the receipts of the fishermen exceeded \$477,730. A feature of the fishery in that year was the increased receipts at Boston and the diminished receipts at New York, although New York, at the end of the year, continued to be the chief center of the business.

The campaign to make an asset out of one of the most destructive and neglected fishes of the Atlantic coast, namely, the spiny dogfish, has progressed rapidly and well, notwithstanding local opposition and a counter campaign of misrepresentation and ridicule among a limited number of people who had become committed to another and impracticable way of combatting the dogfish plague.

Among the first steps taken by the Bureau was to suggest a change in the name of the fish for trade purposes. The species has been generally known as dogfish, a name which is objectionable because of the prejudice against it and is not distinctive because it is shared by various other little-regarded marine and fresh-water fishes. People in all parts of the country will eat catfish but are opposed to dogfish. The name adopted was grayfish, which is descriptive, not preoccupied, and altogether unobjectionable.

Although the authority and the funds for carrying on this work were not granted by Congress until the latter part of June, 1916, midsummer found canners in Maine and Massachusetts making arrangements to pack grayfish, and packing actually began in August under an arrangement made with the Bureau by which the fish was to be prepared in a stipulated manner and sold at a price not to exceed a certain low figure, in return for which the label was permitted to state that the fish was packed in accordance with the recommendation of the Bureau of Fisheries. Another early development was the selling of a limited quantity of fresh fish in the New York market, with the indication that demand would increase.

The destructiveness of the grayfish and the extent to which it has interfered with established fisheries have caused the fishermen to look upon it with such aversion that it was only by the exercise of much persuasion that they could be induced to catch the fish or even to bring ashore those caught incidentally with apparatus set for other fishes. An early feature of the campaign was the complete change in the fishermen's attitude after they had become fully informed as to the Bureau's plans; and the autumn of 1916 witnessed the extraordinary sight of New England fishermen going out especially for grayfish and selling their catch at remunerative prices for food.

Although the canneries took all the grayfish they could obtain, when the fish withdrew from New England waters for the winter the season's pack was not as large as desired by the canners or contemplated by the Bureau in its publicity campaign, and in the marketing of the pack it soon became evident that the demand far surpassed the supply. The canned fish met with very ready sale, and long before the winter was over the entire pack was disposed of and orders continued to arrive from all parts of the country. The goods proved to be not only one of the best canned products on the market but also one of the most economical to the consumer, who could buy at retail for 10 cents a can containing 14 ounces net weight of fish.

The limited quantity of grayfish which the canners found it possible to pack on the Atlantic coast having become exhausted, arrangements were made in December for the inauguration of grayfish canning on Puget Sound, where the fish are found in numbers in winter as well as in summer. The salmon canneries of Washington are idle in winter, and the owners showed much interest in the project presented to them of being able to keep their plants open when they had formerly been unproductive. One cannery began operations almost immediately and by March, 1917, this had been joined by two or three others, while four or five others had announced their intention to experiment with the fish with the view of entering the business if the industrial conditions warranted it. The entire prospective pack of the first concern was contracted for, and it was stated that one packer had been obliged to refuse an order of 20,000 cases on account of the scarcity of cans. A number of orders for export were received but were declined by the canners in deference to the Bureau's desire first to satisfy the heavy domestic demand.

In the latter months of the fiscal year the demand for grayfish continued to increase. Although the canned product had been known to the trade and public only since October, in April, 1917, it was known to be handled by dealers in 128 cities and towns in New York and Pennsylvania alone, and by May the fish was on sale by retailers in 30 States and the District of Columbia.

With the return of grayfish to the coastal waters of New England in the spring of 1917, canning was resumed in Massachusetts, and there is every indication that the output for the calendar year will be greatly in excess of 1916 and that the fish will henceforth have a market for fishermen and packers.

The Office of Home Economics of the Department of Agriculture has conducted experiments in feeding canned grayfish to human beings, and has found that 92.8 per cent of the protein is digested as compared with 94.5 per cent in the highest grade of Columbia River salmon, 93.1 per cent in fresh mackerel, and 91.9 per cent in fresh butterfish. Ninety-five per cent of the fats in grayfish were digested as compared with 94.3 per cent in salmon, 95.4 per cent in mackerel, and 89.9 in butterfish.

Early in the fiscal year the Bureau opened negotiations with the fishery interests of Puget Sound regarding a campaign to increase the consumption of the so-called "black cod," a fish of excellent quality and high food value. In anticipation of the creation of a public demand, considerable quantities were placed in the freezers in Seattle and Tacoma during the summer and fall. The fish is not related to the cod family and in the interest of accuracy it was renamed sablefish, and it began to be exploited under that name in January, 1917. It immediately found a ready market and moved from the cold storage plants so rapidly that it was determined to defer a more vigorous propaganda until spring, when it could be caught in larger numbers. In April, display cards and other advertising matter were issued and its excellent qualities were called to the attention of the public through the newspaper and magazine press. As a result, upwards of 2,000,000 pounds of the frozen fish and 1,304,000 pounds in the fresh state were disposed of by the dealers by June 30, and reports at that time indicated that it was being landed in larger quantities by the fishermen of the Pacific Coast States and that a

considerable fishery was developing in Alaska. The sablefish is abundant along the entire Pacific coast north of San Francisco, and it is believed that it is destined to afford a very important food supply to the country.

A similar undertaking in respect to the burbot was inaugurated about the time of the opening of the Great Lakes fisheries in April. The burbot, which is a fresh-water member of the cod family, is an abundant fish of the large bodies of water of the northern part of the United States, and not only has been neglected as a food resource but on account of its predaceous habits is destructive of other food fishes. Effective cooperation was established with a number of the principal wholesale fish dealers at Great Lakes ports, and about 500,000 pounds of burbot were marketed by them between April 1 and June 30. This fish is generally sold skinned, eviscerated, and headless; and as the price is low it affords an economical food supply of good quality.

Experiments in smoking various species of fresh-water fish, begun at the Fairport station some two years ago, have yielded interesting results. The bowfin or grindle, which is usually regarded as practically worthless, has been found to yield a very superior product when properly smoked. Everyone who has sampled the product has testified to the excellent texture and flavor of the meat and some pronounce it the best of smoked fish. The bowfin is generally known through the Mississippi Basin as dogfish or grindle. It is an abundant form in the Great Lakes and in sluggish waters from Minnesota and New York to Florida and Texas. The proper utilization of this species will not only add another commercial product to the market but will tend to reduce the relative abundance of a species which is most predatory upon the other fishes that are more highly valued in the fresh state.

#### EXPLOITATION OF ALASKAN FISHERY RESOURCES.

An innovation in the Alaska field and a contribution to food preparedness has been the comprehensive campaign inaugurated by the Bureau to encourage the utilization of fishery products heretofore more or less neglected. At the same time attention has been directed particularly toward the packing of herring by the Scotch method, which heretofore has not been attempted in Alaska, all herring for food purposes having been preserved by the more simple Norwegian method. The Bureau secured the services of a recognized authority in the curing of Scotch herring and sent him to Alaska in the spring of 1917. Three special assistants, graduates of the fishery school of the University of Washington, were employed by the Bureau to accompany the expert and acquire all information possible in regard to the improved methods. Several of the regular employees of the Alaska service also were detailed to learn these new methods, so as to be able to instruct the fishermen.

Very gratifying results have followed this campaign, as the fishery interests have shown a marked interest and a desire to give practical effect to the Bureau's work. The herring fishery of Alaska has not been developed to anything like the extent of its possibilities, and as a result of the interest manifested by the trade it is probable that the product in 1917 will be more than double that of any previous season.

It is believed that at least 25,000 barrels of Scotch-cured herring will have been prepared in Alaska in 1917, this in addition to a substantial pack of herring prepared in the Norwegian style. The largest pack of Norwegian herring heretofore made in Alaska in any one year was approximately 18,000 barrels.

Efforts are being made by the Bureau's agents to develop the use of other species of fishes, particularly the sablefish and atkafish. The latter, improperly called atka mackerel, is excellent when salted like mackerel. It is abundant in parts of Alaska but is entirely unknown in the markets.

#### MARKETING CARP ALIVE.

The carp is generally marketed fresh, smoked, or alive, the principal markets being in the large cities in the East which have a foreign population. As a result of various inquiries regarding the feasibility of shipping carp alive from Pacific Coast States to New York City and other eastern points, the Bureau conducted a brief investigation of the methods employed in handling this product. Normally two carloads of carp are shipped each week into New York City, principally from Port Clinton or Sandusky, Ohio, occasionally from other points in the Great Lakes and upper Mississippi Valley region.

The fish are transferred from the nets to large live cars and towed to the shipping point or to retaining ponds to be held for shipment later. Those held in ponds are fed regularly on grain to fatten and harden them. At the point of shipment, the carp are transferred to tanks in the cars, which are usually old baggage cars. Each car is equipped with 8 to 10 galvanized-iron tanks arranged along the sides with a passageway about 2 feet wide running through the center. The space under the passageway serves to hold ice in which the fish which die in transit are iced.

The tanks are about 3 feet wide, 3 feet deep, and 8 to 10 feet long, heavily reinforced with strips of angle iron. A strip of metal about 8 inches wide extends inward from the upper edge to keep the water from sloshing out and the fish from jumping out. When the car is in motion the balance of the opening is covered with a solid cover. Running lengthwise along the bottom of the tanks are one-half-inch galvanized-iron pipes, perforated at intervals of about 4 inches along the upper side with very small, uniform-sized openings for aeration. A wire grating covers these pipes. When the car is stationary or moving slowly, air is passed through the pipes by a pump operated by a set of storage batteries, which are recharged while the car is in motion by a belt attached to the car axle. When the car is moving more rapidly, a floor pump, connected directly with the axle of the car furnishes the necessary power. In warm weather the air, before entering the tanks, is cooled by passing through a set of coils surrounded with ice. In transit the constant attention of a skilled attendant is required to care for machinery and fish.

The amount of fish which can be transported with reasonable safety depends upon prevailing conditions of temperature and distance, varying from about 8,000 to 20,000 pounds.

At the terminus, the fish are transferred to tanks on automobile trucks and delivered to the retailers, who have tanks with running

water for keeping the fish alive. In the live-carp trade, fish weighing from 2 to 3 pounds are preferred. In the fresh (dead) carp trade, fish weighing from 3 to 5 pounds, and for smoking still larger fish, are preferred.

#### DEVELOPMENT OF AQUATIC SOURCES OF LEATHER.

There is a growing scarcity of mammal hides used in the manufacture of leather. The fishermen have no established market for fishskins. A small demand for certain fishskins for special purposes exists, but difficulty is experienced by those using these products to get in touch with sources of supply. These facts have led the Bureau to investigate the possibilities of making satisfactory leathers from fishskins and establishing a market for these products. The tasks confronting it are to induce tanners to develop processes suitable for converting fishskins into high-grade leathers and thus create a market for the raw hides, to instruct the fishermen in preparing the hides properly for the tanner, to encourage them to save and market the skins, to ascertain to what uses the leathers are best suited, and to determine the extent and sources of demand for fishskins for other purposes.

The Bureau has distributed several hundred skins of sharks and other fishes, including cod, hake, grouper, gar, ray, catfish, and wolf-fish, among tanners for experimentation. A number of tanners are interested in the project and are developing processes capable of producing some very creditable leathers. The larger samples have been submitted to the Bureau of Standards for testing as to tensile strength. The average tensile strength of one of the shark skins examined was 3,479 pounds per square inch. Such data are being used for comparison with other leathers. Of the skins tanned, those of the various sharks are the most promising.

Present methods of skinning sharks are slow and tedious. Special instruments have been made and are being tried out for the purpose of overcoming these difficulties. Instructions have been furnished fishermen regarding the curing and packing of skins for shipment, and the names of tanners desirous of obtaining raw materials have been supplied.

Formerly large quantities of shark skins, cleaned but not tanned, were used for polishing wood, ivory, and the like. Because of the roughness, hardness, and durability of the outer surface, they were especially serviceable for this purpose. Although sandpaper and emery preparations have largely replaced such materials, there is still a small demand among cabinetmakers for certain of these hides. It remains to ascertain what hides are best suited to the needs of the various trades and arrange for supplies of these materials. In the past, shark-skin leathers have been used to a very limited extent for various ornamental and novelty purposes. The results of experiments recently made in the tanning of these skins indicate that they can be used on a commercial basis for bag, belt, and similar purposes, and this information is being brought to the attention of manufacturers of such articles. The Bureau is also endeavoring to ascertain whether an industry can be built up which will utilize the skins of smaller fishes, such as cod, hake, grouper, burbot, rays, catfish, etc., on a commercial basis. These and other problems have received

attention, and those obstructive to the development of the industry are being solved.

Congress passed an act, approved June 12, 1917, authorizing the Bureau to conduct a careful investigation in this field. This act carried an appropriation of \$10,000 to enable the Bureau of Fisheries, in cooperation with the Bureau of Standards, to develop new aquatic sources of supply of leather.

## PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

### GENERAL REVIEW OF OPERATIONS.

Conspicuous success and progress have characterized the year's work in fish culture. While the output of several of the important species was less than the average in recent years, the aggregate output was larger than in any previous year, the increase over 1916 being somewhat more than 6 per cent. Among the fishes produced in about the same numbers as in 1916 were shad, whitefish, silver salmon, chum salmon, rainbow trout, and brook trout. Species whose output was smaller were chinook salmon, sockeye salmon, grayling, smelt, black bass, pike perch, yellow perch, white perch, cod, and lobster. Increased production was secured in the case of catfish, buffalofish, silver salmon, humpback salmon, steelhead salmon, Atlantic salmon, landlocked salmon, lake trout, striped bass, pollock, and winter flounder. The somewhat detailed discussion which follows shows the reasons for the gains and losses in the different fields. The total output was 5,158,963,295, compared with 4,847,262,565 in 1916.

Following is a summarized table showing the number of fish eggs and fish distributed by the Bureau in the past year. Most of the eggs herein noted were transferred to various State hatcheries.

## SUMMARY, BY SPECIES, OF THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1917.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Catfish.....			4,251,289	4,251,289
Carp.....		112,000	605,407	717,407
Buffalofish.....		6,754,000	207,898	6,961,898
Shad.....		77,946,000		77,946,000
River herring.....			177,000	177,000
Whitefish.....	52,602,500	331,610,000		384,212,500
Lake herring (cisco).....		82,550,000		82,550,000
Blueback salmon.....	2,000,000	75,038,525	5,793,953	82,832,478
Chinook salmon.....	7,191,200	16,404,404	27,065,581	50,661,185
Chum salmon.....		14,403,300	7,014,580	21,417,880
Humpback salmon.....		27,406,304	7,449,080	34,855,384
Silver salmon.....		4,403,700	4,662,960	9,066,660
Steelhead salmon.....	3,237,600	2,040,710	2,061,709	7,340,019
Atlantic salmon.....		3,028,850	887	3,029,737
Landlocked salmon.....	531,000	798,689	177,635	1,507,324
Rainbow trout.....	1,454,200	250,300	2,574,942	4,279,342
Blackspotted trout.....	1,630,000	2,051,400	2,683,900	6,365,300
Loch Leven trout.....			25,860	25,860
Lake trout.....	35,332,000	33,395,155	3,699,158	72,426,313
Brook trout.....	935,600	5,972,495	7,868,932	14,777,027
Sunapee Lake trout.....		8,000		8,000
Grayling.....	125,000	1,078,000		1,203,000
Smelt.....		28,000,000		28,000,000
Pike and pickerel.....			103,643	103,643
Freshwater drum.....			29,804	29,804
Crappies.....			1,565,072	1,565,072
Largemouth black bass.....		320,050	961,912	1,281,962
Smallmouth black bass.....		237,600	149,837	387,437
Rock bass.....			91,742	91,742
Warmouth bass.....			2,400	2,400
Sunfish.....			2,670,513	2,670,513
Pike perch.....	212,900,000	174,097,500	15,874	387,013,374
Yellow perch.....		175,421,000	103,839	175,524,839
White perch.....		32,625,000		32,625,000
White bass.....			15,298	15,298
Striped bass.....		16,137,000		16,137,000
Mackerel.....		2,341,000		2,341,000
Butterfish.....		920,000		920,000
Cod.....	1,000,000	236,786,000	2,648	237,786,648
Pollock.....		1,474,096,000		1,474,096,000
Haddock.....		6,720,000		6,720,000
Flounder.....		1,814,096,000		1,814,096,000
Miscellaneous fishes.....			16,708	16,708
Lobster.....		110,260,000	5,400	110,265,400
Total.....	318,939,100	4,757,908,782	82,115,411	5,158,963,293

The foregoing output may be conveniently classified on the following geographic basis, which agrees quite closely with the general character of the operations of the hatcheries:

Marine species of the Atlantic coast.....	3,646,827,048
Migratory species of the Atlantic coast.....	333,322,576
Fishes of the Great Lakes.....	926,201,687
Migratory fishes of the Pacific coast.....	206,173,456
Fishes of the interior waters.....	46,438,526

Total..... 5,158,963,293

It is possible to record a further reduction in the unit cost of fish-cultural operations. Taking into consideration all expenditures chargeable to fish culture and fish distribution, together with the salaries of all employees in the fish-cultural service, the cost of fish produced and planted in 1917 was \$114.46 per million, as against \$117.86 in 1916, \$131.65 in 1915, \$146.36 in 1910, and \$239 in 1905. This record is noteworthy in view of the increased cost of all supplies, materials, and temporary labor, and indicates increased efficiency and economy.

## HATCHERIES OPERATED.

During the year the Bureau operated 55 regularly established hatcheries, 19 subhatcheries, and 74 egg-collecting stations. The stations in alphabetical order, with the subsidiary stations thereunder, the period of operations, and the species handled, are shown in the following table:

## FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1917.

Designation.	Period of operation.	Species handled.
Afognak, Alaska.....	Entire year.....	Blueback and humpback salmon.
Seal Harbor, Alaska.....	June-October.....	Blueback salmon.
Ugnak, Alaska.....	do.....	Do.
Baird, Cal.....	Entire year.....	Brook and rainbow trouts, chinook salmon.
Battle Creek, Cal.....	December-April.....	Chinook salmon.
Hornbrook, Cal.....	January-May.....	Chinook and silver salmon, rainbow trout.
Mill Creek, Cal.....	December-April.....	Chinook salmon.
Baker Lake, Wash.....	Entire year.....	Blueback, chinook, silver, and steelhead salmon.
Birdsview, Wash.....	do.....	Blueback, chum, humpback, silver, and steelhead salmon.
Brinnon, Wash.....	do.....	Chum and silver salmon, steelhead salmon.
Berrington, Wash.....	April-June.....	Chum and silver salmon.
Duckabush, Wash.....	October-June.....	Chinook, chum, humpback, silver, and steelhead salmon.
Illabott Creek, Wash.....	do.....	Chinook and chum salmon.
Quilcene, Wash.....	Entire year.....	Chum, humpback, silver and steelhead salmon.
Quinault, Wash.....	do.....	Blueback, chinook, and silver salmon.
Sultan, Wash.....	do.....	Silver and steelhead salmon.
Boothbay Harbor, Me.....	do.....	Flounder, pollock, lobster.
Portland, Me.....	July-October, May-June.....	Lobster.
Bozeman, Mont.....	Entire year.....	Blackspotted, brook, rainbow, and lake trouts, steelhead salmon, grayling.
Odell Creek, Mont.....	March-May.....	Grayling.
Meadow Creek, Mont.....	do.....	Grayling and rainbow trout.
Yellowstone, Wyo.....	July and June.....	Blackspotted trout.
Clear Creek, Wyo.....	do.....	Do.
Columbine Creek, Wyo.....	do.....	Do.
Cub Creek, Wyo.....	do.....	Do.
Lake Camp, Wyo.....	do.....	Do.
Pelican Creek, Wyo.....	do.....	Do.
Bryans Point, Md.....	March-May.....	Shad and yellow perch.
Cape Vincent, N. Y.....	Entire year.....	Brook, lake, and rainbow trouts, lake herring, landlocked salmon, pike, and yellow perch, whitefish.
Chamont, N. Y.....	November and December.....	Whitefish.
Galloo Island, N. Y.....	October-November.....	Lake trout.
Grassy Bay, N. Y.....	May.....	Yellow perch.
Henderson Harbor, N. Y.....	November-December.....	Lake herring.
Ogdensburg, N. Y.....	April-May.....	Pike perch.
Pigeon Island, N. Y.....	October-November.....	Lake trout.
Old Forge, N. Y.....	November.....	Whitefish.
Sodus Point, N. Y.....	November-December.....	Lake herring.
Stony Island, N. Y.....	November.....	Lake trout.
Three Mile Bay, N. Y.....	November-December.....	Lake herring and whitefish.
Upper Saranac, N. Y.....	November.....	Whitefish.
Central Station, Washington, D. C.....	Entire year.....	Shad, pike, and yellow perch.
Clackamas, Oreg.....	do.....	Brook and rainbow trouts, steelhead, chinook, and silver salmon.
Applegate, Oreg.....	April-June.....	Chinook, silver, and steelhead salmon.
Big White Salmon, Wash.....	December-March.....	Chinook salmon.
Snake River, Oreg.....	October.....	Do.
Little White Salmon, Wash.....	July-May.....	Chinook and chum salmon.
Rogue River, Oreg.....	Entire year.....	Blackspotted trout, chinook, steelhead, and silver salmon.
Upper Clackamas, Oreg.....	do.....	Chinook, steelhead, and silver salmon.
Willamette River, Oreg.....	July and June.....	Shad.
Cold Springs, Ga.....	Entire year.....	Base, catfish, sunfish.
Milltown, Ga.....	May.....	Base.
Craig Brook, Me.....	Entire year.....	Atlantic, humpback, and landlocked salmon, brook trout.
Duluth, Minn.....	do.....	Brook and lake trouts, pike perch, whitefish, steelhead salmon.
Grand Marais, Minn.....	October-December.....	Lake trout, whitefish.
Sault Island, Minn.....	November.....	Lake trout.



## FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1917—Continued.

Designation.	Period of operation.	Species handled.
Edenton, N. C.....	Entire year.....	Black bass, shad, sunfish, white perch.
Weldon, N. C.....	April-May.....	Striped bass.
Erwin, Tenn.....	Entire year.....	Brook and rainbow trout, black bass, carp, sunfish, rock bass.
Fairport, Iowa.....	do.....	Black bass, buffalofish, carp, catfish, crappie, drum, pickerel, pike, perch.
Black River, Ark.....	October-December.....	Black bass, buffalofish, carp, catfish, crappie, pike perch, sunfish, suckers.
Cumberland River, Ky.....	November-December.....	Black bass, crappie, sunfish.
Lake Cooper, Ill.....	August-December.....	Black bass, buffalofish, carp, catfish, crappie, pickerel, sunfish, pike and yellow perches.
Lake Pepin, Minn.....	September-November.....	Black bass, buffalofish, carp, catfish, crappie, pickerel, pike perch, sunfish, yellow perch.
Gloucester, Mass.....	Entire year.....	Butterfish, cod, flounder, haddock, lobster, mackerel, pollock.
Green Lake, Me.....	do.....	Brook trout, steelhead, landlocked, and humpback salmon, smelt.
Grand Lake Stream, Me.....	September-June.....	Landlocked salmon.
Homer, Minn.....	Entire year.....	Black bass, buffalofish, catfish, carp, crappie, drum, pike, rock bass, sunfish, yellow and pike perches, brook and rainbow trout.
La Crosse, Wis.....	do.....	Black bass, buffalofish, carp, catfish, brook trout, crappie, drum, pike, pike perch, rock bass, sunfish, yellow perch.
Leadville, Colo.....	do.....	Blackspotted, brook, rainbow, and lake trout, grayling.
Antero Lake, Colo.....	April-May.....	Rainbow trout.
Crystal Lake, Colo.....	November.....	Brook trout.
Englebrecht Lake, Colo.....	October-November.....	Do.
Hoselkuss Lake, Colo.....	do.....	Do.
Musgrove Lake, Colo.....	do.....	Do.
Northfield Lake, Colo.....	do.....	Do.
Smith Ponds, Colo.....	do.....	Do.
Turquoise Lake, Colo.....	do.....	Do.
Uneva Lake, Colo.....	do.....	Do.
Woodland Park Lake, Colo.....	do.....	Do.
Seven Lakes, Colo.....	June.....	Blackspotted trout.
Louisville, Ky.....	Entire year.....	Black bass, crappie, pike perch, rock bass, sunfish, chinook salmon, rainbow trout.
Mammoth Spring, Ark.....	do.....	Black bass, catfish, rock bass, sunfish.
Friar Point, Miss.....	July-December.....	Black bass, buffalofish, carp, catfish, crappie, rock bass, sunfish.
Manchester, Iowa.....	Entire year.....	Brook and rainbow trout, rock bass, smallmouth bass.
Bellevue, Iowa.....	August-December.....	Black bass, buffalofish, carp, catfish, crappie, drum, pike, sunfish, warmouth bass, white bass, yellow perch.
North McGregor, Iowa.....	do.....	Black bass, buffalofish, carp, catfish, crappie, pike, rock bass, sunfish, yellow perch.
Galena, Ill.....	November.....	Black bass, buffalofish, carp, drum, pike, river herring, sunfish, warmouth bass, yellow perch.
Nashua, N. H.....	Entire year.....	Brook, lake, and rainbow trout, smallmouth bass.
Neosho, Mo.....	do.....	Black bass, crappie, rainbow trout, rock bass, sunfish, yellow perch.
Northville, Mich.....	do.....	Brook, lake, and rainbow trout, smallmouth bass.
Alpena, Mich.....	April-May.....	Lake trout, whitefish.
Bay City, Mich.....	April.....	Pike perch.
Bay Port, Mich.....	November.....	Whitefish.
Brevort, Mich.....	do.....	Do.
Belle Isle, Mich.....	October-November.....	Do.
Charity Island, Mich.....	do.....	Do.
Charlevoix, Mich.....	April-May, November.....	Lake trout, whitefish.
Chelboygan, Mich.....	October-November.....	Lake trout.
Detour, Mich.....	do.....	Do.
Detroit, Mich.....	April-May, December.....	Pike perch, whitefish.
Fairport, Mich.....	October-November.....	Lake trout.
Frankfort, Mich.....	do.....	Do.
Grand Haven, Mich.....	do.....	Do.
Isle Royale, Mich.....	do.....	Lake trout, whitefish.
Keystone, Mich.....	do.....	Lake trout.
Leland, Mich.....	do.....	Lake trout, whitefish.
Manistique, Mich.....	do.....	Lake trout.
Marquette, Mich.....	do.....	Do.
Monroe, Mich.....	April-May.....	Pike perch.

## FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1917—Continued.

Designation.	Period of operation.	Species handled.
Northville, Mich.—Continued.		
Munising, Mich.	October-November.	Lake trout.
Muniscoog, Mich.	April.	Pike perch.
Naubinway, Mich.	October-November.	Whitefish.
Northport, Mich.	do.	Lake trout, whitefish.
Ontonagon, Mich.	do.	Lake trout.
St. Ignace, Mich.	do.	Lake trout, whitefish.
St. James, Mich.	do.	Lake trout.
St. Joseph, Mich.	do.	Do.
South Manitou, Mich.	December.	Whitefish.
Port Lookout, Mich.	do.	Do.
Orangeburg, S. C.	Entire year.	Black bass, sunfish.
Branchville, S. C.	March-April.	Shad.
Jacksonboro, S. C.	do.	Do.
Put in Bay, Ohio.	Entire year.	Lake trout, whitefish, pike, perch.
Middle Bass, Ohio.	April, November-December.	Pike perch, whitefish.
North Bass, Ohio.	do.	Do.
Port Clinton, Ohio.	do.	Do.
Toledo, Ohio.	do.	Do.
Quincy, Ill.	Entire year.	Black bass, buffalofish, catfish, crappie, pike perch, rock bass, sunfish, yellow bass, yellow perch.
St. Johnsbury, Vt.	do.	Brook, lake, rainbow, and sunapee trouts, landlocked and steelhead salmon, yellow perch.
Darling Pond, Vt.	July-December.	Brook trout.
Holden, Vt.	Entire year.	Brook, lake, and rainbow trouts, steelhead and landlocked salmon.
Lake Mitchell, Vt.	September-December.	Brook trout.
Swanton, Vt.	April-May.	Pike and yellow perches.
Berkshire, Mass.	Entire year.	Brook trout.
San Marcos, Tex.	do.	Black bass, crappie, rock bass, sunfish.
Saratoga, Wyo.	do.	Blackspotted, brook, and rainbow trouts, steelhead salmon.
Spearfish, S. Dak.	do.	Brook, blackspotted, lake, rainbow, and Loch Leven trouts.
Tupelo, Miss.	do.	Black bass, catfish, crappie, sunfish.
White Sulphur Springs, W. Va.	do.	Brook and rainbow trouts, black bass, sunfish.
Woods Hole, Mass.	do.	Cod, flounder, mackerel.
Menemsha, Mass.	January-April.	Flounder.
Waquott, Mass.	do.	Do.
Wickford, R. I.	do.	Do.
Wytheville, Va.	Entire year.	Black bass, brook and rainbow trouts, rock bass, sunfish.
Yes Bay, Alaska.	do.	Blueback salmon.
Smeaton Bay, Alaska.	August-September.	Do.

Early in the fiscal year an additional hatchery was added to the number already in operation, through the acceptance of a donation by Mrs. Mary A. Scully of a trout-hatching plant which had been constructed and successfully operated as a private venture for some years by her husband, the late John S. Scully, of Massachusetts. This property consists of about 135 acres of land in the heart of the Berkshire Hills, some 7 miles from Great Barrington, Mass., with the ponds and buildings required for a complete trout hatchery. A joint resolution of Congress, authorizing the Secretary of Commerce to accept the gift on behalf of the Government was signed by the President on July 28, 1916, and shortly thereafter the Bureau instituted active trout operations with the stock of fish included as a part of the donation.

## DISTRIBUTION OF THE HATCHERY OUTPUT.

The output of the hatcheries, planted under favorable conditions and in well-considered places, reached every State and Alaska. The commercial fishes were distributed for the most part in local waters,

on the initiative of the Bureau and under the immediate direction of the various station superintendents. The fishes adapted for the minor interior waters were largely planted on applications from States, clubs, associations, and individuals bearing the indorsement of Senators or Representatives.

In the course of the year the fish-distributing cars traveled a total of 138,717 miles, the paid transportation amounting to 122,778 miles. Although the output of fish was larger than ever before, a material reduction in distribution expenses by messengers was effected, through the systematic planning of the work with the view of supplying all species without covering the same territory twice. By this means the messenger travel of 645,721 miles in 1916 was reduced to 554,597 miles in 1917. The average cost per mile for movement of the Bureau's cars, based on data compiled for the fiscal year 1916, was \$0.144, including fares of the car crews.

A new fish transportation car, for which Congress had provided an appropriation of \$20,000, was completed and put in commission shortly after July 1, 1916. This car is of steel construction throughout except for the doors and windows, and is equipped for carrying 140 cans of fish. Its use has greatly facilitated the distribution work, as it carries a load almost 50 per cent larger than the old cars.

Small shipments of eggs have been made to foreign countries, in response to official requests. Thus, there were forwarded to Canada 96,000 rainbow-trout eggs and to Japan 100,000 brook-trout eggs and 101,000 rainbow-trout eggs. To the Canal Zone there were sent 2,750 fingerling, black bass, catfish, rock bass, and sunfish, at the request of the canal administration.

A detailed statement of the distribution and planting of fish is published separately as a part of this report, and is available for gratuitous distribution. This statement shows by States and localities the number and age of fish of each species distributed during the year.

#### PROPAGATION OF THE PACIFIC SALMONS.

The run of both red and humpback salmon in the vicinity of the Afognak station was the largest that has occurred in that region since the year of the eruption of Mount Katmai in 1912. In connection with the run of the former species, it is noteworthy that Litnik Lake was the only point in the ash belt where any number of redfish were noticeable, and nearly all the other lakes which they frequented before the eruption were barren. Whether this run, consisting of individuals of an inferior size, was affected by remote influences or was in part or altogether the result of the hatchery plantings is conjectural.

Collections of red-salmon eggs extending from July 26 to October 18 amounted to 22,424,000, of which 4,678,000 were taken at Seal Bay and 692,000 at Uganak Bay. To these acquisitions was added a gift of 1,016,000 eyed eggs from the Karluk hatchery of the Alaska Packers Association. Some of the later eggs were more than seven months in process of hatching, due to the fact that the water temperature remained around 33° F. until after the middle of April, following a very severe winter. Fry began taking food late in April, and 8,871,000 were on hand at the end of the fiscal year after 10,296,000 had been liberated. Freshened salt salmon, a by-product of spawning operations, was fed with satisfactory results. Its prepa-

ration consisted in soaking in running water for 24 hours, removing skin and bones, and grinding. It was next placed in boiling water, which caused the flesh to granulate, and was then reground. When granulated by the boiling-water treatment a greater proportion is eaten, whereas when the raw flesh is reduced to a fine state by the second grinding a large part, in the form of a milky fluid, is lost when put into the water. The fry are fed from six to eight weeks, and released only when it becomes necessary to provide feeding space for more recent hatchings.

At Litnik Lake 25,310,000 humpback-salmon eggs were collected between August 11 and September 11. At Seal Bay 3,010,000 of this species were obtained and more were in sight, but collecting had to be discontinued in order to reserve space for redfish eggs. At Uganak Bay when 10,730,000 had been taken all space was filled and collections were necessarily suspended. Late in October all these eggs were transferred from the field stations to Afognak hatchery and the auxiliaries were closed. In the course of the season, a transfer of 16,000,000 humpback-salmon eggs was made to Seattle, Wash., half of them being destined to Puget Sound stations and half to stations in Maine. The 19,343,000 humpback fry produced at Afognak were held as long as possible, but owing to lack of room it was necessary to plant them prior to sac absorption. Most of them were released in the river below the lake and were widely scattered so that they might settle in crevices between the rocks covering the river bed.

Although the run of red salmon in the vicinity of Yes Bay station was commercially far below that of the preceding year, a good collection of eggs was made. Although the number secured was not as large as in the previous year, when 72,000,000 were taken, the figures of the average year were surpassed by several millions.

While facilities for rearing were limited, more than 800,000 fingerlings were produced and liberated in the course of the season and 785,500 were being held at the end of the fiscal year. From 58,000,000 eggs collected, mainly in September, 49,600,000 fry were liberated, and 2,000,000 eyed eggs were supplied to the Oregon State hatchery at Bonneville. The salt-solution process was employed for the removal of dead eggs.

The combined output of fingerling salmon from the Washington stations was above 37,000,000, while upward of 3,000,000 additional, in process of rearing, were carried over into the new fiscal year. Steelhead fingerlings released numbered nearly 4,000,000. Egg collections at these stations were generally successful, though diminished because of the off year for humpback salmon. A feature at Birdsvie station was the taking of 38,000 humpback-salmon eggs. This species has heretofore visited these waters only every second year, and this appearance in Grandy Creek can not be regarded otherwise than the result of the Bureau's effort to establish an annual run by the transfer of eggs from Alaska. Conditions were most unfavorable during the humpback run, Grandy Creek being at a low stage, and the water spread out over the wide gravelly bar at the creek's mouth, making it difficult for fish to enter. No eggs were taken at any other Washington station, although fishermen, noting their off-year appearance, made reports from various places which indicated the taking of quite a number. Alaska humpback fry, the product of 4,000,000 eggs, were again introduced in this stream. The same conditions that hampered

the entrance of humpbacks into the creek prevailed during the sockeye run, otherwise larger results would undoubtedly have been recorded. In the spring, several sockeye salmon, from 6 to 10 inches in length, were taken in the creek. Another shipment of 225,000 eggs was sent from Quinault station in order to continue the plantings in Puget Sound.

Low water curtailed the chinook-egg collections in the Puget Sound region, but hatching results were good, the fry taking food more readily and developing more rapidly than any other species. The steelhead run was late, but nearly as many eggs were collected as last year, and over a million were transferred to Maine and other points eastward. The take of silver-salmon eggs was 2,000,000 in excess of last year.

At Baker Lake the sockeye-egg collections numbered 5,445,000, surpassing the previous year by 2,000,000. An unusual occurrence was the fact that about 22 per cent of the eggs could not be fertilized, though the fry resulting from the fertile ones were normal. The silver-salmon eggs were infertile to a somewhat greater extent. A battery of troughs was set up outside the hatchery for the rearing of fry. All fish were fed to some extent prior to releasing them. All chum and silver salmon fry at Darrington station were reared to the feeding stage. There was an increase in the aggregate egg collections of chinook, chum, silver and steelhead salmon at Illabot Creek station, but at Day Creek a falling off occurred. All eggs at the latter point were transferred to Birdview for hatching. At Sultan station a washout reduced the egg collections. All fry at this point were fed prior to release. A slough pond, 150 by 4 feet in area and 1½ feet deep, was constructed, and used with excellent results for holding and feeding young fish.

At Duckabush station there was an unusually small run of chum salmon, and as trouble was experienced from log jams, at least half the run of chum and all the silver salmon escaped capture. At Brinnon station, though conditions were like those at Duckabush, increased collections of silver and chinook salmon eggs were made, despite the fact that unlawful purse-seine fishing was conducted below, for which some of the fishermen were convicted by State authorities. Most of the steelhead run at this station escaped when the rack was washed out in May or when log jams prevented fishing. The work at the Duckabush and Quilcene stations was greatly facilitated by the purchase of two motor trucks during the latter part of the fiscal year.

An interesting item in connection with the work at this field was the result attained from feeding in the so-called slough pond, an arm of the Walcotts Slough, which was screened to exclude enemy fish. All the salmon fry hatched at Brinnon, and the younger specimens of fish forwarded from Duckabush and Quilcene, were placed in this pond and fed regularly. They made a rapid growth and the losses were slight. They were allowed to pass out at will, the meshes of the screen being large enough to permit their escape. The chum salmon left the slough at the end of four or five weeks, although they had in almost every case been fed for about the same length of time in troughs or cement ponds before their transfer to the slough. The chinook and silver salmon remained for a longer period and left the slough in a body.

difference in the mileage is 52, whereas the difference in the rate is 41 cents a hundred, or \$8.20 a ton, which is the differential maintained against the shorter haul at Grand Junction, Tenn.

Now, then, in justifying this discrimination, the Interstate Commerce Commission said, justifying the discrimination between New York and Memphis:

There is a disconnected service between New York and Memphis, regular boats plying between Natchez and New York and Memphis. The water competition is to be regarded as potential, but not actual, and the testimony in this case indicates that any material advance in the rates from New York to Memphis would, without doubt, result in reestablishment of active competition on the Mississippi River.

Mr. WETTRICK. Mr. Shaughnessy, do you remember that Commissioner Clark said in the Shreveport case there was no long-and-short-haul question involved?

Mr. SHAUGHNESSY. Mr. Clark and I do not exactly agree on that. Of course when we come right down to a literal interpretation of the Shreveport-Texas discrimination it classes as third-section discrimination. In other words, undue preference between communities—between the community of Louisiana on the one hand and Texas on the other; but the point I make is that the Shreveport discrimination on inbound business from the north is due to fourth-section violations predicated upon the potential competition of the Red River and its proximity to the Mississippi River through the port of Vicksburg. This gave Shreveport lower rates on its inbound business from St. Louis and Kansas City than was given to Fort Worth, Dallas, and other mileage-equivalent points in Texas, and this discrimination the Interstate Commerce Commission has failed to remove. And in this connection, let me also state that Shreveport itself suffers long-and-short-haul discrimination, as intermediate on the direct lines from St. Louis and Kansas City to New Orleans, where there has been no water competition worth speaking of for years. As to the Shreveport and the Texas situation, therefore, we have parallel lines of railroad running direct from St. Louis and Kansas City to both Shreveport and Dallas. These lines operate under substantially similar circumstances and conditions and from an operating standpoint there is absolutely no reason why there should be any difference in the rates. Yet, for a distance of 562 miles from Kansas City to Shreveport, the rate on agricultural implements is \$10 per ton for a 562-mile haul, whereas the rate on the same commodity from Kansas City to Dallas over a 515-mile haul is \$13.80. Take canned goods as another example, the rate from Kansas City to Shreveport is \$6.60 per ton for the longer distance than to Dallas, where it is \$9.20 per ton. Now, that shows that the long-and-short-haul discrimination did enter into the Texas-Shreveport case and because the Texas Railroad Commission undertook to offset this inbound discrimination maintained against Texas by lowering the local rates within the State of Texas, the Interstate Commerce Commission stepped in under the third section of the act to regulate commerce and found that the action of the Texas commission operated as a burden upon interstate commerce, and incidentally in removing this so-called discrimination as between localities, the commission has assumed jurisdiction over all local rates in Texas to

the exclusion of the State legislature, its courts, and its railroad commission—and this in the face of the commission's own admission that it has no power to make anything other than a maximum rate and alternative orders for the removal of discrimination, under which the carriers may make any kind of a rate adjustment that they see fit. Now, as reinforcing and more fully elucidating the Texas situation I want to offer at this point the testimony of Mr. Byars, of the Fort Worth Traffic Bureau, and the testimony of Commissioner Mayfield, of the Texas Railroad Commission.

In connection with the Byars letter that I have submitted here, I wish to give reference to the testimony which Mr. Byars gave before the Senate Committee on Interstate Commerce, on June 30, 1916, on Senate bill 5242, and I ask to have it incorporated with Mr. Byars's letter, his testimony beginning at page 44 and ending on page 54.

(The testimony referred to is here printed in full, as follows:)

**STATEMENT OF MR. ED BYARS, REPRESENTING THE FORT WORTH BUREAU, FORT WORTH, TEX.**

MR. BYARS. Mr. Chairman, I see that the Hon. Earl B. Mayfield, of our State railroad commission, is here, and as I am very anxious that he should be heard by the committee I will make my statement as brief as possible.

In discussing this bill it will not be necessary for me to review in detail all the incidents in the Shreveport case leading up to the present time. Suffice it to say that the Interstate Commerce Commission set aside the Texas commission's rates when it ordered in a scale of class rates from Dallas to points in east Texas on the Texas & Pacific and from Houston to points in Texas northeast thereof on the H., E. & W. T. However, the scale there fixed as far as it went, which was 182 miles on the T. & P. and 230 miles on the H., E. & W. T., was the same as the Texas commission's scale, the only difference being that the western classification was ordered to be used in connection with it instead of the Texas commission's classifications. The western classification contains a majority of higher ratings but it also contains some lower ratings than the Texas classification. Three out of the seven members of the commission dissented from the opinion on the apparent ground that they did not have the authority to make State rates in view of section 1 of the act to regulate commerce, which specifically provides that they did not have such authority. What did the Supreme Court do when this case was appealed to it? It examined the law and came to the conclusion that the Interstate Commerce Commission has the power to make State rates wherever such action becomes necessary to preserve the freest flow of commerce among the States.

Of course, the Supreme Court's interpretation is the law of the land, and stands as such until the Congress speaks again and leaves no such question open to interpretation but specifically provides that under no circumstances shall State-made rates be set aside unless and until they have been carefully examined into as to their reasonableness and found to be unreasonable by a court of competent jurisdiction. In the Shreveport case the reasonableness or the unreasonableness of the Texas rates per se was not examined into at all. The particular rates under examination have been the rates from Shreveport into east Texas points and from east Texas points into Shreveport, La. Those are the only rates the Interstate Commerce Commission ought to have the right to fix, because they are interstate and because that was the purpose of the act to regulate commerce.

We believe that the State should have the right to make rates and to regulate railroads in the matter of transportation charges just as much so as regulate them in the matter of the issuance of stocks and bonds or requiring them to make track connections or any other orders affecting their revenues whatsoever. Secondly, the Interstate Commerce Commission, at the present time, is wholly unprepared to take over the work of making rates on the intrastate traffic of all the separate States.

The State of Texas has next to the longest State line of any State in the Union. Its intercoastal canal and two navigable rivers—the navigation of each of which is being extended—its vastly differing soil and climatic condi-

tions, crop productions, etc., its mountainous section, its marshy rice lands; and all of those things must be considered in connection with its transportation conditions.

The railroads at the Shreveport hearing, in the supplemental order, seemed to suggest taking the level of the rates from Shreveport into Texas, which are admittedly very high, and the Texas commission scale, which the carriers claim is too low, and strike a level half way between the high and low points and making that level the basis for both the Texas intrastate rate and the interstate rates from Shreveport; in other words, grade the Texas rate up and grade the Shreveport-to-Texas rate down. That is a most unjustifiable proposition, because it is presupposing that the Shreveport rates are somewhat near reasonable rates and that the Texas rates are too low. The Shreveport people, in my judgment, ask for rates from Shreveport into Texas on traffic that never moves and never has moved and never will move from Shreveport into Texas, and it seems to me it is a proposition as to which the Shreveport people are being somewhat misled.

I would like to read from the brief filed by the Fort Worth Freight Bureau in Docket 3918 just an extract from page 25 [reading]:

"The complainants' principal object in bringing this case was to get into Texas with their goods, the greater portion of which are received on low inbound carload rates (which great advantage they expect to retain), and some very few of which goods are manufactured at Shreveport. But it so happens that they do not manufacture brick in Louisiana to any very great extent, and practically none at Shreveport. Therefore, any rates that might be prescribed from Shreveport to Texas points on this commodity would be merely paper rates, and we do not think that this commission will feel justified in going to the extreme lengths of increasing the Texas rates in order to establish a scale of rates for the benefit of Shreveport's brick manufacturers of the future.

"There are probably three or four brick plants in the State of Louisiana, making only the low grade common brick; they have not the clay from which to make any other kind of brick, and very little of that. Therefore no necessity exists for any rates from Shreveport to Texas.

"It is approximately 1,000 miles, rough speaking, across the State of Texas from Brownsville to Texline; there are 125 brick plants in this State—one for every 12½ miles. From Texarkana to El Paso it is 850 miles, or one brick plant for every 7 miles.

"The last available Government Statistical Report (1913) shows that Texas produces practically three times as many brick as Louisiana, and that no face, front, fire, or paving brick are manufactured in Louisiana.

"Under the circumstances, certainly no necessity exists for this commission, in prescribing reasonable rates to and from Shreveport, to disturb the present rates in Texas."

I would like also to read an extract from an address made by Judge William D. Williams, of the Railroad Commission of Texas, at Austin, on June 13, referring to the Sheppard amendment. Judge Williams said:

"Because of its great size and the large volume of purely State transportation in Texas, the shippers and citizens of this State are probably more seriously threatened than those of any other States, by the startling innovation inaugurated under authority of what is known as the Shreveport rate case; and yet while this is true the extent to which that case goes is generally overestimated and its effect misconceived. Indeed, I might say that if it had a greater effect, while it might substantially destroy the autonomy of the State, it would likely be less dangerous both to State and interstate shippers. For the decision of the Supreme Court of the United States divides the control of State rates between two bodies, the one State and the other National, and these two bodies, each with its incomplete control, have no means of acting together. It is not correct to say that the Interstate Commerce Commission makes rates in Texas. The Supreme Court of the United States expressly holds that it has no such power. What the commission does when it interferes is to annul rates made by the State commission and authorize the railroads to substitute therefor rates that are higher and that may be as high as the railroads desire to make them. It says, in effect, that the rates from Shreveport into Texas are greater than the rates between Texas stations for the same distances on the same commodities; we order that these differences be corrected, and we find that certain rates from Shreveport into Texas are reasonable, and these rates must not be increased. Now, under this order, the Supreme Court holds that the railroads may remove the discrimination which



has been found to exist against Shreveport by increasing the Texas rates. This leaves to the railroads the following options: They may reduce all rates to or even below the Texas level, they may reduce the Shreveport rate part way and increase the Texas rate up to the same point; or they may increase the Texas rate to or above the Shreveport rate and let the Shreveport rate stand as it is. Obviously so large a discretion will be used by the railroads to their own advantage as far as they dare go.

"Instances of this are already in existence. When the railroads put in their tariffs on the Texas & Pacific Railway from Dallas east to the State line, and on the Houston, East & West Texas Railway from Houston northeast to the same line, they carefully raise all the Texas rates until they were as high as the rates from Shreveport into Texas; but there were certain other rates which from before the beginning of the case were higher in Texas than the rates from Shreveport into the State on the same commodities. The roads made no change in these tariffs, and the Interstate Commerce Commission had no power to and did not attempt to compel them to do so. The result is an equalization of rates per ton mile so far as Shreveport is concerned, but the retention of discriminations against Dallas and Houston and other Texas jobbing points.

#### "DISCRIMINATION AGAINST TEXAS.

"Discriminations have also resulted against Texas cities in the matter of minimum weights for carloads. Where these minimum weights were lower in Texas than on like commodities moving from Shreveport into the State, they have been raised to the same figure, but where they were already higher than the interstate minimums they have not been reduced but remain higher to this day.

"Nor is this all. Upon a supplemental application, the Interstate Commerce Commission by its order attempted to enforce equality of rates over all of what it calls east Texas, which includes the Santa Fe Railroad to the Brazos River and down the river to its mouth and everything to the east and north. A further application is now pending and may be decided any day which asks the extension of this equalization westward to the Rio Grande River and its application throughout all Texas.

"Shreveport never was and so far as a human being can tell never will be in competition for business in ninety-nine one-hundredths of this vast territory over which it seeks to control the rates. There are large numbers of comparatively well-informed merchants in many places in Texas who, except for the notoriety given it by this case, would have never heard of Shreveport and would have lived and died ignorant of its existence, but prosperous and happy notwithstanding their ignorance.

"Shreveport is not a factor in Texas business, and yet grave consideration is being given by the Interstate Commerce Commission to the claim which it makes of a legal right to control that business and to shape its destinies. It desires to say which of our industries may live and which shall die. It seeks the power to destroy commercial centers within our borders and to build up others in their stead.

"Shreveport is not in a grain-producing territory, neither is it a center for the handling of that commodity. If it ships any grain into Texas during the year, it is probably not in carload lots and it is certainly not in larger quantities. The carload rate from Shreveport to Big Sandy, a distance of 80 miles, is 15 cents, and the carload rate for an equal distance in Texas is 11½ cents. There is a very large carload movement in Texas. There is comparatively, and probably literally, no carload movement from Shreveport into Texas, yet Shreveport would claim, and was in a fair way to secure the right in the eastern Texas district, to increase the Texas rate 35 per cent in order to save from discrimination a commerce which did not exist. The Shreveport carload rate on flour to Big Springs, some 480 miles, is 30 cents, while the rate in Texas for the same distance on the same commodity is 20 cents. If this effort succeeds, the Texas rate is to be raised by 50 per cent, and again this is done for the purpose of protecting a commerce which does not exist and which can not be produced until climatic and soil conditions are entirely changed throughout the effected territory.

"It is not possible to give all the instances in detail, and it must be enough to say that I have not been able to find an exception where the result aimed at would not increase the Texas rate on grain and grain products by from 35 to 200 per cent.

"Shreveport ships practically no live stock into Texas, but it has a rate per car to Waskom of \$16.50, while the rate per car on live stock in Texas for the same distance is \$11. The Shreveport rate to Hawkins, 94 miles, is \$25.30, while the Texas rate for the same distance is \$18. The Shreveport rate to Terrell, 158 miles, is \$33 per car, while the Texas rate for the same distance is \$22. The Shreveport rate to Dallas is \$35.75 per car, while the corresponding Texas rate of \$24. The Shreveport rate to Fort Worth is \$38.50 per car, and the Texas rate for the same distance is \$26. These are fair instances, for here again the rule is universal that the Shreveport rate is higher than the Texas rate. As I have said heretofore, Shreveport does practically no business in live stock either with Texas or with any other place. In Texas the raising of live stock is a vast industry with an investment of many millions of dollars, and upon it depends the fortunes and even the lives of tens of thousands of our people. An increase of the Texas rate such as would be necessary to equalize it with the rate from Shreveport would reflect a greater injury to the stock raisers of Texas than a year absolutely without rainfall, and yet the Interstate Commerce Commission, even if it decides this claim against Shreveport gives months and months to its consideration. With all seriousness, it considers propositions which would destroy our producers and would substitute for it something which can do Shreveport itself no good whatever, except as it might rise upon the ruins which it has created across the border and throughout this State.

"The rates on crude petroleum if it were raised to equal the Shreveport demand would be increased from the present Texas rate by anywhere from 33 to 100 per cent. The rates on sand and gravel would be doubled for the short distance for which such rates are applicable interstate. The rates on brick would be increased anywhere from 30 to 120 per cent.

"The rate on coal from Dallas to Forney, 20 miles, has been increased from 55 cents per ton on a minimum carload of 20 tons, to \$2.50 per ton on a minimum of 24 tons. If this sort of rate is put in force all over Texas or over the eastern district, our coal mines will close down in short order.

"And even this going on through an almost interminable list is not all."

Mr. BYARS. In another part of the speech he says that the Texas rates are always more than compensatory and that the railroads are seeking, through the Shreveport decision, to throw off the control on regulation by the State commission and make rates as they please [reading]:

#### "TEXAS PAYS TOO MUCH.

"The average freight rate already paid in Texas on strictly State business was 12.92 mills per ton-mile for 1914 and 1915, while the average rate on interstate business in Texas was 8.34 mills per ton-mile for the same period. In plain English this means that Texas business is now and in the past has been paying on the average 55 per cent more freight for the same service when done altogether in Texas than was charged if the shipment crossed the border line. Yet the Shreveport interstate rate into Texas is much larger than the Texas rate itself. And this again means that other interstate rates are far less than those from Shreveport.

"Now, if Texas freight rates must be based upon interstate rates, why not give us the benefit of the low rates? Why force us to take as a basis the highest rates which can be found? Even the Texas railroads themselves, when they applied to the Texas commission for increased revenues, asked no such increases as they are authorized to make by eastern Texas order of the Interstate Commerce Commission.

"Examine the New Orleans rates into Texas for a moment and compare them with those from Shreveport. Agricultural implements from Shreveport pay 4.09 mills per ton-mile average to Texas points west of Marshall. From New Orleans they pay 2.4 mills per ton over the same rails, passing through Shreveport on the way to the same destinations. The Shreveport rate is 66 per cent the higher. Bagging and ties from Shreveport, 1.8 mills per ton-mile. From New Orleans, 1.1 mills per ton-mile. Difference in favor of New Orleans of about 70 per cent. Print paper from Shreveport, 3.6 mills per ton-mile. From New Orleans, 1.8 mills—exactly 50 per cent of the Shreveport rate.

"Why not let Texas have the New Orleans rate? Why compel it to take the highest interstate rates found across its borders?

"The Interstate Commerce Commission has refused to raise interstate rates for the purpose of increasing railroad revenues. In all courtesy, I ask them

to consider well if, having acted thus, it is fair and just to increase those same revenues by forcing increases of State rates.

"The fact is that the order of the Interstate Commerce Commission, when applied, produced monstrous and absurd rate situations within Texas, and the Interstate Commerce Commission, misconceiving, as I believe, its powers and duties, is undertaking to correct these situations which are matters affecting State commerce alone. Under the decision of the Supreme Court the Interstate tribunal may destroy Texas rates, but it can not replace them. The State commission alone can repair the damage done to State commerce by the Interstate body."

Mr. BYARS. I have a pamphlet here, printed by the railroad commission of Texas, which gives a synopsis of the Shreveport case in very lucid terms. It contains the argument of the Hon. Sam H. Cowan, of counsel employed by the Texas interests, and I would like to file it for the information of the committee.

The CHAIRMAN. Would you like to have that printed in the hearing?

Mr. BYARS. Yes, sir; it might be very instructive.

Senator SHEPPARD. I had intended to present that myself, and I am very glad to have Mr. Byars do it.

The CHAIRMAN. It will be incorporated in the record.

(The pamphlet referred to is here printed in full, as follows:)

#### "THE SHREVEPORT CASE.

"Before the Interstate Commerce Commission. Docket Nos. 3918, 8290, and 8418. Railroad Commission of Louisiana, complainant, v. St. Louis Southwestern Railway Co. et al., defendants.

"The supreme importance of the question involved and the ultimate result which might follow a decision of the Interstate Commerce Commission and the courts to practically abolish the railroad commission of the State of Texas, and the inestimable injury to the State of Texas which might follow the final adverse decision in the case, leads me, as one feeling a great interest in the subject matter, to submit for the information and consideration of the public such matters of law and fact as to warn the public of its danger.

"The fact that there has been no manifestation of public interest in this case would seem somewhat strange and could be accounted for mainly, no doubt, because of the lack of definite information with respect to the results which possibly may follow, and the fact that the final results have not yet come.

"Considering the great controversy arising from the appointment of the railroad commission of Texas, and to that end, of the amendment of the constitution in order to regulate the rates, rules, and regulations and practices of the railroads and transportation within the State, it is still more remarkable that when the public is confronted with the proposition that the Interstate Commerce Commission may abolish the constitution, statutes, and acts of the railroad commission of Texas, comparatively little heed has been paid to it.

"On March 11, 1912, the first of these cases was decided by the Interstate Commerce Commission, opinion by Commissioner Lane, reported in 23 I. C. C., 31. The essential matters in controversy are thus stated by Commissioner Lane (p. 33):

"This proceeding places in issue the right of interstate carriers to discriminate in favor of State traffic and against interstate traffic. The gravamen of the complaint is that the carriers defendant make rates out of Dallas and other Texas points into eastern Texas which are much lower than those which they extend into Texas from Shreveport, La. A rate of 60 cents carries first-class traffic to the eastward from Dallas a distance of 160 miles, while the same rate of 60 cents will carry the same class of traffic but 55 miles into Texas from Shreveport. For further illustration of the rate situation, reference is made to the appendix of this report.

"The railroad commission of Louisiana has brought this proceeding under direction of the legislature of that State for two purposes: (1) To secure an adjustment of rates that will be just and reasonable from Shreveport into Texas; and (2) to end, if possible, the alleged unjust discrimination practiced by these interstate railroads in favor of Texas State traffic and against similar traffic between Louisiana and Texas.

"The railroads deny that the rates out of Shreveport are unreasonable, but place their defense mainly upon the proposition that they are compelled by the railroad commission of Texas to effect the discrimination here involved."

"The commission, after elaborate reasoning with respect to the powers conferred upon it by the act to regulate commerce, held in its final conclusion that the existing class rates out of Shreveport to Texas on the Texas & Pacific Railway and on the Houston East & West Texas Railway, were unjust and unreasonable, and fixed a scale of class rates to be applied up to a distance of 182 miles on the Texas & Pacific Railway and 230 miles on the Houston East & West Texas Railway.

"It was held that the maintaining of the higher rates to and from Shreveport and points in Texas than are maintained from cities in Texas to such points, constituted an undue preference and advantage to the Texas cities, and a discrimination that is undue and unlawful against Shreveport; hence that the order should be issued directing the carriers to maintain rates no higher than the scale prescribed as between the points named, and that the Texas & Pacific Railway Co. and the Houston East & West Texas Railway Co. cease and desist charging higher rates on commodities from Shreveport than are contemporaneously charged for the carriage of such commodity toward Shreveport for an equal distance.

"Commissioners Clements, Harlan, and McChord dissented, holding that the commission was without jurisdiction to fix the State rates. Commissioner Prouty concurred, but in his concurrence stated (p. 49):

"While this commission can not establish and should not attempt to establish, directly or indirectly, a State rate, it must in the exercise of the duty put upon it by the act to regulate commerce determine whether the discrimination exists, and in doing that it may and should examine the State rate in comparison with the interstate rate."

"So it appears from the three dissenting opinions and the qualifying concurring opinion of Commissioner Prouty that had the case turned upon the matter of fixing the State rates, it would have been decided adversely by the Interstate Commerce Commission.

"This case reached the Supreme Court (234 U. S., 342, 58 L. Ed., 1341) on the question as to the right of the Interstate Commerce Commission to make an order in accordance with its findings, which are sufficiently outlined above, and the decision of the commission and its order was upheld by the Supreme Court, which in its final conclusion said (234 U. S., 369, 58 L. Ed., 1351):

"So far as these interstate rates conformed to what was found to be reasonable by the commission, the carriers are entitled to maintain them, and they are free to comply with the order by so adjusting the other rates, to which the order relates, as to remove the forbidden discrimination. But this result they are required to accomplish."

"The first section of the act to regulate commerce as originally passed and continued up to this time contains the following proviso with respect to the transportation of passengers and property.

"*Provided, however,* That the provisions of this act shall not apply to the transportation of passengers or property, or to the receiving, delivering, storage, or handling of property wholly within one State and not shipped to or from a foreign country from or to any State or Territory as aforesaid."

"The Supreme Court held that this proviso did not apply to this case, and in construing it the Supreme Court said (234 U. S., 358, 58 L. Ed., 1351):

"These words of the proviso have appropriate reference to exclusively intrastate traffic, separately considered; to the regulation of domestic commerce, as such. The powers conferred by the act not thereby limited where interstate commerce itself is involved."

Thus the proviso in section 1 of the act supports the contention that Congress intended to give the Interstate Commerce Commission the power which it exercised in the case. Thus stands the law on that subject at this time.

"In June, 1914, the Louisiana commission, and as the record shows the Shreveport commercial interests, brought a petition for a supplemental order to extend the rate structure as established in the previous decision to the whole State of Texas. This the Interstate Commerce Commission declined to do, but divided the State into eastern Texas by a line drawn through Gainesville and thence down to the Brazos River and to its mouth and prescribed a scale of rates for the territory on that line and east thereof, which should be applied to shipments wholly within the State of Texas moving toward Shreveport. Following upon that decision, which was rendered June 17, 1915, the roads published their class rates on traffic between all stations in east Texas and filed the same with the Interstate Commerce Commission and furnished copy thereof to the Texas commission. The Interstate Commerce Commission in this supplemental case, also with respect to the territory denominated eastern Texas,

provided for and ordered that the carriers should cease and desist charging higher rates on any commodity from Shreveport into eastern Texas than was charged for the carriage of such commodities for an equal distance from eastern Texas toward Shreveport, and that such commodity rates should not exceed class rates. Those commodity rates were not published. The western classification was required to be observed.

"Upon the publication of these class rates in eastern Texas protests were filed by various commercial interests of the State against the same, and the commission suspended the tariffs and directed an investigation of the entire subject matter involved in all the Shreveport cases, which included the further supplemental petition of the Railroad Commission of Louisiana, in which it was again sought to have the action of the commission in prescribing rates within the State of Texas extended to the entire State.

"The whole matter was heard at Houston before Commissioner Hall and has been briefed and argued before the commission. If the commission should sustain the former decision and the contention of the Louisiana commission, the effect would be that the Interstate Commerce Commission would prescribe the rates within the State of Texas and apply thereto the western classification and exercise all such powers in regard to the matters pertaining to transportation as it might exercise in regard to the interstate rates, and then the Texas commission, for all practical purposes, would be abolished. It would not do to say that the Interstate Commerce Commission might adopt in some instances, or might adopt in all instances, the rates as fixed by the State commission because the proposition back of it all is that the power and authority exists with the Interstate Commerce Commission and not the Railroad Commission of Texas.

"As subsequently will be pointed out, the remedy therefor lies with Congress to restrict the power of the Interstate Commerce Commission so that it can not have this effect, and in order to do so, to amend the proviso of section 1 as has been quoted hereinabove, of the act to regulate commerce so as to place it beyond cavil that as to all intrastate transportation, rates, rules, and regulations the power of the Texas Railroad Commission may be exercised.

"As stating what is believed to be the correct position of the State and the position which was taken by the Dallas Chamber of Commerce and Fort Worth Freight Bureau, the argument made by S. H. Cowan before the Interstate Commerce Commission in opposition to the exercise of such power by the Interstate Commerce Commission is submitted, as follows:

**"ARGUMENT OF MR. S. H. COWAN.**

"Mr. COWAN. May it please the commission, time is at least the essence of this argument. I have prepared some matters that go to the very foundation of this case which I desire to present to the commission, and I have, therefore, reduced them to writing in order that I may make no mistake in regard to them, and which, with your forbearance, I will read.

"Reduced to its last analysis, the issue in this case is whether the Interstate Commerce Commission, should it find a difference in rates per mile in Texas as fixed by the Texas commission, intrastate, compared to rates between Texas points and Shreveport, declare that to be a discrimination, and, based on that, take jurisdiction to prescribe all rates, classification, rules, and regulations of all intrastate traffic within the State, and thereby supersede the former rates and regulations of the State of Texas, whether made by the Texas commission or the legislature.

"Stated in another form, to abolish the State commission and set aside the State laws, and even deprive it of the benefits of its constitution providing for the railroad commission.

"These carriers seem to think they have found an easy road to accomplish these wonderful ends, almost by a simple twist of the wrist, but they may find it a rocky one before the end of the journey which starts with loud acclaim.

"It was mentioned by this commission in the previous decisions of the cases now on rehearing that the Texas commission was not a party, and though some of its members were present at the hearing, did not offer any evidence. Whether that is by way of criticism or rebuke of the Texas commission, it has been made use of by these carriers as such.

"It has no place here. The five millions of people of the greatest State of the Union, almost in its swaddling clothes of development, with its 16,000 miles of railroad, and its great harbors, are not subject to a judgment by default

before this commission that will deprive the people of Texas of control and utilization of these facilities in intrastate transportation, to the upbuilding of its great industries.

"The Texas commission has the right to stand on the constitution creating it and the law defining its powers, and to proceed to exercise that power as an agency of the State according to its judgment for the upbuilding of that great Commonwealth, and in the manner which it deems fair to the railroads as an important factor in the progress of the people. This we must assume it has done to the best of its ability under the constitution and laws of its creation, and is not to be censured because it did not appear in a case like this where those rights are sought to be taken away.

"This case at the threshold marks a milestone on the road of railroad control, leading to the abolishment of State commissions and repeal of State statutes by the commission, or to a clearly defined limitation of the powers of this commission. It means the control or not of the commerce and development of the State by its own policy as to intrastate commerce or a control of intrastate commerce by this commission.

"The only source of that jurisdiction contended for is where this commission finds a discrimination—an unjust discrimination—in State railroad rates and transportation and interstate.

"Whether the fact of unjust discrimination exists involves a multitude of things and conditions, and is at last a mere mental conclusion, and may be a mere figment of the imagination, yet it is to be taken as a means of destroying the entire rate situation of a State or control of its local commerce.

"The very essence of the jurisdiction of this commission to act at all is dependent on that finding.

"No discrimination can exist except by the effect of some act prejudicial to the complainant or others, and a mere difference in the amount of freight rates in one locality compared with another can not be a discrimination unless it affects the business interest of the localities or persons served or commodities transported. That must depend on the inbound as well as the outbound rates, yet the commission in this case has ruled out of consideration the inbound rates.

"In this it is in error, as is shown by the decisions of the Supreme Court of the United States, as well as its own decisions.

"At page 46 of my brief I have cited the Texas & Pacific case. This commission will remember that case as being one of the initial cases with respect to undue preference, that being a case where the commission declined to consider the fact that freight had come in by vessel to New Orleans. In reversing that case and sending it back to the commission, the Supreme Court of the United States said:

"The very terms of the statute, that charges must be reasonable, that discrimination must not be unjust, and that preference or advantage to any particular person, firm, corporation, or locality must not be undue or unreasonable, necessarily imply that strict uniformity is not to be enforced, but that all circumstances and conditions which reasonable men would regard as affecting the welfare of the carrying companies, and of the producers, shippers, and consumers, should be considered by a tribunal appointed to carry into effect and enforce the provisions of the act."

"For the entire period of its existence the commission did not suppose it could control interstate traffic or rates up to the decision of this case.

"Is it not a long step to change the power itself of that control to this commission even in the twinkling of an eye by this commission finding that there is a discrimination between State rates on intrastate traffic and interstate rates on interstate traffic? Can it be supposed that any such metamorphose was even thought of by Congress? That is to say, can it be supposed that Congress, not having specifically provided for such a condition, could have supposed that this commission should exercise jurisdiction of the control of the intrastate traffic by the mere fact of finding that in a given instance there was a discrimination? Let that discrimination be corrected. It ought to be corrected. It is within the jurisdiction of this commission to require it to be corrected; but to make use of that finding to draw to itself jurisdiction in their control of all intrastate rates in Texas, and, therefore, the classifications, rules, and regulations, as it seems to me, is something that never could have been thought of as intended to accomplish that object; neither did the original decision in this case attempt to do so. If you will observe in the concurring opinion of Judge Prouty, he stated that this commission could not attempt, directly or indirectly, to control

the intrastate rates. This commission went no further in that case than to define what the rates ought to be and the basis of those rates to and from Shreveport. That, we concede, is entirely within its jurisdiction, but to make use of the mere fact of the existence of the discrimination to take charge of the entire subject of the making of all rates and rules and regulations, and, therefore, of the conditions of transportation within the State of Texas, was a marvelous jump in the line of trying to control the rate subject of this country.

"The relationship of the railroads and the complainants manifests itself by the absence of controversy as between them on any point and a concurrence of all of them in seeking the same thing in the same way.

"The prime object of the railroads is to obtain an increased revenue on Texas intrastate business.

"At the conclusion of the supplemental hearing the examiner observed that they—complainants and defendants—had no dispute. In the decision of the commission in the same case it was stated that there were no new facts developed except a tentative agreement to extend the making of intrastate rates in Texas over the entire State instead of a division of it on and east of the main line of the Santa Fe from Gainesville to the Brazos River, thence to its mouth, in which territory this commission prescribed the rule to be observed.

"That agreement has been put into actual operation here by the new complaint, and they all unite in the contention that to prescribe the rates which you did prescribe would result in a most anomalous condition; would produce discriminations and upset the entire traffic of the State. Therefore they have all united in the contention that you are to fix intrastate rates throughout the entire State of Texas because of a mere 20-mile haul from the State line to Shreveport. To use the language of Gov. Roberts in speaking of San Augustine in his notable book, he said it was the center of the surrounding country. According to the proposition asserted here, Shreveport is the center of the earth, and you should take that into consideration, because there is discrimination practiced by the railroads there which they could readily remove, certainly at the smallest sort of expense, and that you are to seize jurisdiction just because of that.

"They all agree upon another proposition, that Shreveport should be treated as though it were within the State of Texas. We could better afford to buy that entire territory than to visit Mr. Atkins or Mr. Luther Walter on the public, who, like the Pied Piper of Hamelin, draw everybody to them, and with their flute they follow. It seems to be the most marvelous proposition I have ever seen, transforming the jurisdiction transmitted by our constitution to our commission and visiting a burden on this Interstate Commerce Commission which it is unprepared to fulfill.

"On the hearing for the increase in Texas rates before the Texas commission, and after class tariffs had been published which are suspended in this proceeding, I. & S., 710, a motion was made by the attorneys for the Texas commission to dismiss or indefinitely postpone the further consideration of their application for increased rates because they were denying the jurisdiction of the Texas commission and asserting that the Interstate Commerce Commission had jurisdiction to prescribe the rates within that part of Texas called east Texas, for which they had filed their tariffs making the increases those which they desired. But they strongly fought that proposition, and the expressions in reply thereto were that the Texas commission ought to advance the Texas rates, and if it did so to a point satisfactory to the railroads, the same would be applied to Shreveport traffic.

"Now the railroads come forward with a list of commodities where satisfactory advances have been made, another where some advances have been made that are not enough to satisfy them, and another in which no response has been made by the Texas commission to the application for advances.

"As I say, they have confronted you with the statement or a list of some of those advances that have been made, and, as Mr. West said, they are willing to apply them to Shreveport and thus relieve it that far. Some advances have been made which do not suit them, and therefore I assume they do not expect to go by the Texas rates in that particular; and in other instances no report has been made by the commission. The object of obtaining greater revenue being at the foundation of the action by both the complainants and the railroads, it is so apparent that a wayfaring man, though a fool, need not err therein. It is a conspiracy in which the minds of all meet and concur to the end of obtaining additional revenue for the railroads in the State of Texas, and so the burden

of the complaint, as shown by the argument here, and as shown by their briefs, is that they are not getting enough revenue. It is not for this commission to resort to increasing the intrastate rates in order to produce revenue for them; neither can you assume jurisdiction because you may think they are not getting enough, because that jurisdiction has not been committed to you.

"Take the single item in which we have been very much interested for a great many years, the item of beef cattle. (I have come to a point where they call me a steer, which is denied.) On beef cattle in Texas the single line rate for 200 miles is 17.5 cents; that is, for distances from 200 to 230 miles under the Texas commission's scale the rate is exactly the same—17.5 cents. The Texas commission's rates on beef cattle and stock cattle are made by the mileage scale, not just every mile counted, but it jumps a certain amount in cents per hundred pounds for certain increased distances. For instance, 200 miles is 17.5 cents and 229 miles is 17.5 cents. Why could they not apply the Texas scale with all reasonableness to such few shipments as go into Shreveport? That would have been an easy proposition. Furthermore, the small amount of shipments that move there could not have affected these railroads. It simply shows you that the intention in alleging discrimination there is for the purpose of having you fix a higher scale for the entire State of Texas for the handling of the product of more than 6,000,000 head of cattle a year and to take out of the hands of the Texas Railroad Commission the making of these rates. That is their object, and none other. Will this commission lend itself to that? If it finds a discrimination existing in the cattle rates under the Texas scale, and under some scale they have made into Shreveport, will they not require the adoption of the Texas scale to Shreveport rather than enter upon the great undertaking of fixing the whole of the rates within the State of Texas for the transportation of the enormous number of cattle that are transported in that State? The same thing will apply to nearly all sorts of traffic that moves by the mileage scale. Take, for example, up to 245 miles, according to your class tariffs and you will find the same thing. It is but slight trouble to have applied the Texas commission rates as they existed in those cases, as Mr. West assures you they have done or will do in these cases where the Texas commission has now advanced certain commodities. Why not? That is the simple way to do it.

"As I said in the outset, this proceeding marks a new departure in the progress of railroad regulation in this country. It can not be expected that the people will give up their first experiment of controlling rates and regulations within the State, abolish the State commission, and deprive their legislature of the power to act itself should it see fit to do so, just because of the mere finding of this commission that some discrimination exists in some given instance.

"I trust this commission will consider this subject from the standpoint that if you have jurisdiction to remove the discrimination you will not resort to the method which has been pointed out. It reminds me of a case where, in trying a murder case, an old gentleman was called as a venireman. Under our Texas statute each venireman is required to rise and answer questions touching his qualifications to serve, and the first question is, "Have you any conscientious scruples in regard to inflicting the death penalty as a punishment for crime?" When that question was propounded to this old gentleman, he said, "Well, judge, I don't reckon I have, but," he said, "I think it ought to be very sparingly administered." So it is with this commission. They ought very sparingly to administer that enormous jurisdiction which the Supreme Court seems to give them when it comes to stepping into a State and fixing State rates because of some discrimination that exists somewhere.

"I must hasten to another point for fear I overstep my bounds in time.

"Mr. Commissioner Lane said in the first opinion that if the inbound rates to Shreveport were artificial—that is, made by the railroad—then that was to be taken into consideration. The record in this case shows that none of the shipments move into Shreveport except by railroad. I am invoking, therefore, that doctrine announced by this commission in that case, and when you adjusted the Texarkana-Shreveport rates relatively you then considered the fact of the movement of traffic in by rail to both places, but you gave to Shreveport a somewhat lower rate on some things at least if the traffic moved through the Vicksburg Crossing.

"There is no difficulty in adjusting this discrimination except the difficulty that arises out of the desire on the part of our railroad friends to secure larger earnings for themselves in Texas. Maybe they ought to have them, but this is not the tribunal to come to to get them simply by first securing



you to say that there is discrimination, and therefore you will take over the fixing of all of those rates. It is just like the case of the doctor who said if he could throw a man into fits he knew that he could cure the fits.

"The railroad commission of Texas has a multitude of things to consider. How could we establish a glass factory, Mr. West, on the Missouri, Kansas & Texas Railroad at Wichita Falls without some advantages that would move that glass out to the points of consumption? It was moved there from a point in Kansas. Innumerable things of that kind move into Texas. Can we have nothing to say with regard to the development of industries in our great State? Shouldn't we be accorded rates which, under the circumstances, are reasonable and which will produce revenue which was not produced before? It is not a reduction of revenue. It is an increase of revenue. So it was throughout the entire hearing for the railroad commission of Texas.

"Many instances were brought up where it was shown that increased rates would actually reduce the revenue, so if revenue is the question for this commission to decide, you have not half heard the case. I say it is not. The commission has no power or jurisdiction because of its desire to increase the revenue, to take jurisdiction over the rates, regulations, and practices of the State of Texas in order to cure a discrimination which can be done with great ease by simply adding the 20 miles to the Texas rates according to the scale of the Texas rates, and where it happens that that will increase the rate, then let it be increased, but where it happens that it would not increase the rate anyway, then the very same privilege would exist for Shreveport when it ships in the other direction into Texas. You will have to consider the facilities for doing business. You will have to consider what it costs them to secure the raw material, as in the case of peanuts, which have been mentioned here, in order to know whether or not there is a discrimination. It can not exist in the abstract. It is always in connection with the facts. Those facts must apply to something concrete, something that is being done, and when they speak of the fact here that Shreveport can go only such and such a distance, and that Dallas and Fort Worth can only go such and such a distance, why is it? Because of two rates, the inbound and the outbound, and the cost to manufacture. It is said, of course, that in many cases this commission will not attempt to adjust commercial conditions, and yet you can not decide the question of discrimination in any other way than by considering who it hurts, how it hurts them, and what it is that hurts them.

"So it is in this case that I figure, if I may be permitted to say so, that this commission has made a mistake in not considering the inbound rail rates to Shreveport as well as to north Texas points.

"One more point, your honors: It was assumed that the rates up to 245 miles were not too high, but there was no evidence in the record in the original case, and there was none in the supplemental case, outside, perhaps, of an expression of opinion given by my friend, Mr. Atkins, for whom I have the very highest regard as to his ability, but maybe not so much respect for some of his opinions—as I say, there was no testimony to show that those conditions and circumstances of transportation were the same.

"It is announced here that there is a different situation when you apply the matter of relative conditions to traffic moving north and south and to that moving east and west. Certainly. Why?

"You take the main line of the Gulf, Colorado & Santa Fe Railroad, that moves traffic to Fort Worth and Dallas, and look in I. & S., 555, at the freight operation sheets which were filed in that case, and you will find there that the density of traffic on the main line of the Santa Fe in Texas runs more than 1,000,000 tons per mile of line. It is one of the heaviest densities of traffic in this whole country. You will find the main line of the Missouri, Kansas & Texas runs that. Those main lines are the ones which handle this stock traffic. You will find that so far as the Cotton Belt Railroad is concerned, it can scarcely furnish the axle grease for the cars that haul its ties. There is the Cotton Belt on one side and the Texas & Pacific on the other, both reaching Shreveport, both reaching there from Fort Worth. The Texas & Pacific are making money, and the Cotton Belt people say they are losing money. How in the world they have lost it for those 30 years I don't know, but they say they have been losing it for 30 years. Does that show a difference in the condition of transportation? If these railroads are not prosperous to some extent in Texas I would like to know why. We have had the greatest railroad development in Texas in the last 10 years by far of any other State in the Union. The Santa Fe has plastered the Panhandle all over with railroads,

and they have one of the best railroads there is in the West, and are still acquiring and building railroads, not right at this time because they have an abundance of them. Of course the Orient Railroad can not make any money, and the Brownsville Railroad can not make any money. A lot of these railroads were built in anticipation of a development which did not take place, and consequently they can not make any money, but none of that is a question for this commission to decide. The question is, Should the discrimination at Shreveport be removed? Let the railroads remove it as they please. If they think they can develop railroad commission rates, as Mr. Commissioner Lane suggested, let them try it. They can not plead here that this was put in by the rules of the commission of Texas. That was one of the things which was urged in the original case. Those rates have been charged in Texas. They said, "You made no effort to withdraw them."

"Don't forget another thing. There was a time when the Texas commission, on account of the Texarkana situation, made a certain percentage of reduction in rates up to Dallas and Fort Worth and that territory, but that has long since passed. It was one of those emergency rates that were taken out, and the flat rate applies to-day just as it does all over the State. You can not assume that at the end of 245 miles these rates are a factor upon which to build an additional charge. Why? Because these rates up to 245 miles were made with the view of taking care of the extra haul that would move beyond that for no additional charge. Do you suppose the railroad commissioners of Texas were so ignorant that they did not look at it that way? Judge Reagan was there at the time the compromise was made and the rates were agreed to, but it was not a binding agreement. It could not be under the law. They were put in, however. They were not ignorant men.

"The 245 miles embraced within is compensation for the balance of the transportation into common point territory. To use that as a factor here on which to begin to build your additional rates is a subject that I say this commission is not investigating. The Texas & Pacific has a very heavy density eastward, but the Cotton Belt does not. Furthermore, the movement of empty cars, which is an enormous proposition when it comes to the matter of expense, is northbound and eastbound, whereas, from Shreveport into Texas the empty movement is far less in proportion.

"The CHAIRMAN. You have consumed your time. If you desire to do so, the commission will be glad to have you file with the reporter any part of your argument which you were unable to present.

"Mr. COWAN. There are a great many matters that I would like to urge before this commission, but I think I have pointed out enough already to show the absurdity of the method that is now being attempted to be enforced upon this commission.

"I thank you."

"The position of the Louisiana interests and of the Texas railroads was in support of the Interstate Commerce Commission exercising this power. The Louisiana interests wanted to secure all of the benefits of the Texas rates or to deprive the Texas people thereof, and the railroads to use this means of securing an increase in revenue.

"It is plain, therefore, that under the decision heretofore rendered by the commission, and the decision of the Supreme Court here referred to, that if the people of this State are to have the benefit of regulation by law or by the Texas commission, of the railroad rates, regulations, and practices as applied to purely State business, it must seek that right through an act of Congress. It is safe to say that no State is so situated that the Interstate Commerce Commission may not find a discrimination existing by virtue of the State rates compared to the interstate, and based upon that finding to take over the jurisdiction, should it decide to do so, and prescribe all the State rates and matters pertaining to transportation and which affect the service and rates.

"Therefore, to secure the rights of the State which have been exercised up to the date of this decision, the proviso of the first section of the act should be so amended as to read:

"*Provided, however,* That the provisions of this act shall not apply to the transportation of passengers or property, or to the receiving, delivering, storage, or handling of property wholly within one State and not shipped to or from a foreign country from or to any State or Territory as aforesaid: *And provided, further,* That the fact that a discrimination or a preference may be found to exist by reason of the difference between any State rate, classification, rule, regulation, or practice of any common carrier and the interstate rate, classifica-

tion, rule, regulation, or practice of such carrier, whatever the effect may be upon interstate commerce, shall not authorize the Interstate Commerce Commission, by virtue of any of the provisions of the act to regulate commerce, to in any way annul, abridge, or modify the power of the State, exercised through its legislature or through any commission or agency established for that purpose, to prescribe all such rates, classifications, rules, regulations, and practices as may be provided by the laws of such State, or to interfere with the free exercise thereof, with respect to intrastate transportation or commerce.'

"With this amendment the law will be as it was supposed to be at the time of the enactment of section 1 in 1887, leaving to the States their rights in the premises with respect to strictly intrastate business, and leaving to the Interstate Commerce Commission its full powers and jurisdiction with respect to interstate business. The question is: Shall the State regulate the State business and preserve the power of the Constitution, laws, and agencies to that end? If so, the power of Congress must be invoked to do so."

Mr. BYARS. That is all I care to say. Mr. Chairman.

Mr. SHAUGHNESSY. I ask at this point to have introduced the testimony of Earle B. Mayfield, commissioner, of the Railroad Commission of Texas, beginning at page 61, and also the testimony of Hamlin Palmer, of the Amarillo Chamber of Commerce, beginning at page 89. This testimony now relates to the Shreveport situation.

(The matter referred to is here printed in full, as follows:)

STATEMENT OF MR. EARLE B. MAYFIELD, RAILROAD COMMISSIONER, STATE OF TEXAS.

Mr. MAYFIELD. Mr. Chairman and gentlemen of the committee: I am here to represent the State Railroad Commission of Texas in favor of the Sheppard bill, and I desire to thank the committee for giving me an opportunity to make a few remarks in favor of Senate bill 5242, as introduced by our junior Senator. Before discussing the merits of the bill, however, I desire to reply briefly to certain remarks made by Mr. Dorsey, of Texas.

From the reading of the statement by Mr. Dorsey, which he has just filed with the committee, I could not tell whether he was in favor of the Sheppard bill or whether he was opposed to it, and I am sure the committee experienced the same difficulty, but being acquainted with the gentleman, and knowing something about his maneuvers with reference to rate matters down in Texas, I knew in advance that Mr. Dorsey was opposed to the Sheppard bill, and so I take this opportunity to inform you of the gentleman's position.

Mr. Dorsey says that he represents the Farmers' Union of Texas. I challenge that statement and call upon Mr. Dorsey to show his credentials. Mr. Dorsey has no more authority to speak for the Farmers' Union of Texas here in opposition to this measure than has the attorney for the railroads, who sits by his side. I am a member of the Farmers' Union of Texas myself, and I know something of the sterling manhood and patriotism of the men who compose that organization, and I say to you, Mr. Chairman, that Mr. Dorsey is placing the Farmers' Union of Texas in a false light before this committee, when he stands here and claims that he has authority to represent the Farmers' Union of Texas in his opposition to the Sheppard bill.

The greatest political controversy that ever occurred in Texas was between James S. Hogg and George Clark. This contest occurred back in the nineties and the main issue between these two distinguished statesmen was whether or not a railroad commission should be created in the State of Texas. Hogg championed the creation of the commission and Clark opposed it. The contest was long and bitter and will ever be remembered in the political history of our State. All special interests, including the railroads, supported actively the candidacy of Mr. Clark, but the farmers of Texas rallied to the support of their friend, James S. Hogg, and he was elected governor of our State and the railroad commission was established. The Railroad Commission of Texas, Mr. Chairman, owes its creation more to the farmers of our State than probably to any other class of people. The farmers of Texas believe in their railroad commission, and when I see a farmer from our State appear before this committee, claiming that he represents the Farmers' Union of our State and oppose a bill introduced by the junior Senator of our State, the purpose of which bill is to keep our State commission from being de-

stroyed, it makes me blush with shame. I repeat, Mr. Chairman, that Mr. Dorsey has no authority to speak for the Farmers' Union of Texas against this measure, and we ask this committee not to consider him as a representative of the Farmers' Union of our State. If Mr. Dorsey has the authority, it will not take him long to produce it, and I again call upon him to show us where he got his authority to speak for the Farmers' Union of our State.

Mr. Chairman, the Texas commission has been conducting an investigation into the question of the reasonableness of our State rates. That investigation has covered over a year. During that time the commission received a number of letters from Mr. Dorsey, requesting the commission to raise the freight rates on cotton, live stock, etc., and advising the commission that the farmers of Texas were willing to stand an increase in freight rates on all farm products. These letters, received under the signature of Mr. Dorsey, were so written that they bore suspicious earmarks, and we summoned Mr. Dorsey to appear before the commission and to testify as to who wrote those letters. The records of our office will show that Mr. Dorsey testified that most of those letters were written or prepared by Mr. R. D. Bowen, of Paris, Tex., a man who spends a great deal of his time in the city of New Orleans and at other points in the State of Louisiana. A few days ago Mr. Bowen was compelled to give his testimony before the commission of Texas, and when interrogated as to whether or not he wrote the letters which the commission had received under the signature of Mr. Dorsey, did not deny nor controvert the testimony of Mr. Dorsey, but admitted that he had assisted and had aided in the preparation of most of those letters. When Mr. Bowen was confronted with the vouchers from the Gulf, Colorado & Santa Fe Railroad, showing that he had received the sum of over \$1,500 during the thirtieth legislature for services rendered that railroad in behalf of its merger bill and against the 2-cent passenger bill, he admitted to having received the money, but claimed that none of the money went to him directly, but was paid to him for the purpose of reimbursing him for what he had paid out to others. These are the men, Mr. Chairman, who are here opposing the measure which seeks to protect the life and integrity of the Texas State Railroad Commission.

Now to the merits, Mr. Chairman, of the measure that is before you for consideration. The distinguished gentlemen from Louisiana would have this committee believe that the only question that is involved in this controversy is whether or not the city of Shreveport, La., should have fair and just rates. They are correct in saying that the necessity of the Sheppard measure grew out of the decision of the United States Supreme Court in the Shreveport rate case. They are not correct, however, when they claim that the Sheppard bill would nullify the benefits which the city of Shreveport has won under the decision of the Supreme Court of the United States. They are clouding the issue, Mr. Chairman. We say unhesitatingly that every rate discrimination against the city of Shreveport should be removed. Not for a moment would we contend that the city of Shreveport or any other city in this Union should be discriminated against.

We want no wall erected around the State of Texas, because we desire commerce to flow freely between Texas and our sister States. Right here, Mr. Chairman, I desire to make reply to a statement which has often been made in certain quarters to the effect that the policy of Texas was to encircle itself with a wall for the purpose of protecting home industries. That statement is not true, and the man who makes it is either not posted on the history of rate regulations in this country or he makes it with the deliberate intention of placing the Railroad Commission of Texas in a false light. Years ago, before the Interstate Commerce Commission had been granted the power to prescribe maximum rates, the Railroad Commission of Texas promulgated a tariff carrying rates 20 per cent less than the regular tariffs. This particular tariff applied only to a limited territory in the northeast section of our State, commonly known as the "burnt district." The interstate rates into the "burnt district" from outside jobbing centers were much less than the interstate rates to the cities of Dallas, Fort Worth, Paris, Clarksville, and Greenville. Bear in mind, gentlemen of the committee, at that time the Interstate Commerce Commission was powerless to make rates. John H. Reagan, who was chairman of the Texas commission at the time the 20 per cent reduction tariff was promulgated, stated that the Texas commission would go to the Interstate Commerce Commission for relief, but that the Supreme Court of the United States had decided that the Interstate Commerce Commission could not make rates, and therefore it was useless to appeal to the Interstate Commerce Commission.

What did the Texas commission then do? It promulgated a tariff carrying rates 20 per cent less than the regular tariffs applying only to the territory above mentioned. What was the purpose of the tariff? Was it to protect the merchants and manufacturers of Texas? No man who knew John H. Reagan would for a moment make such a claim, because the very mention of the word "protection" was nauseating to him. That special tariff was put into effect to protect no one, Mr. Chairman. Its sole purpose was to give to the people of that territory the benefit of competition and to enable the jobbing interests and manufacturers of Texas to compete in that territory with outside interests.

But that is past history, Mr. Chairman. That special tariff has been canceled. Besides the present commission can not be bound by the acts of three commissioners 20 years ago. Precedent, indeed, has its weight in deciding these issues, but the Railroad Commission of Texas does not follow precedent altogether. The acts of yesterday may not be the acts of to-morrow, and the present commission of Texas stands for free trade with all our neighbor States, and we say "Shreveport is entitled to have fair and just rates."

The question which I desire to discuss for a short while, Mr. Chairman, is one that rises above the question of fair and just rates to Shreveport. These men are not here opposing the Sheppard bill because it would prevent Shreveport from having fair and just rates, because it would not. They are here in opposition to the Sheppard bill because they know that if the Sheppard bill becomes a law they will be blocked in their efforts to secure for Shreveport rates to which she is not justly entitled. In the first application before the Interstate Commerce Commission in the Shreveport case all that was asked was the discrimination against the city of Shreveport caused by the interstate rates from that city into Texas being too high be removed; but, gentlemen of the committee, the Interstate Commerce Commission is now asked to strike down the entire system of the Texas State rates as promulgated by the Texas commission. So the issue is not a local one. It has so enlarged since the first hearing in the Shreveport case that we are now confronted with a situation that affects the welfare and prosperity of every State in the Union.

When the National Association of Railway Commissioners met in annual convention in this city, November 17-20, 1914, it adopted a resolution which declared that a State rate on purely State traffic should not be struck down until a court having proper jurisdiction had found it to be unreasonable, and the Sheppard bill simply seeks to carry that resolution into effect. I call attention to the passage of that resolution by the National Association of Railway Commissioners to refute the statement that the Sheppard bill deals only with a local condition.

The Sheppard bill is short and simple. There can be no misunderstanding as to its terms. It simply provides that before a State rate on purely State traffic can be nullified it must be found to be unreasonable by a court having proper jurisdiction. It says let that rate stand which is the reasonable rate. Can there be any objection to such a proposition? How these gentlemen can oppose this bill is beyond my comprehension. The bill appears to me to be so fair and just that the reading of its terms proves the equity of the proposition.

To see the necessity of the Sheppard bill, Mr. Chairman, it is absolutely necessary to briefly refer to some of the incidents growing out of the Shreveport case.

The Shreveport case originated in 1910, when the Legislature of Louisiana appropriated the sum of \$15,000 for the purpose of prosecuting their complaint before the Interstate Commerce Commission. In 1911, on March 8, the Railroad Commission of Louisiana filed a complaint before the Interstate Commerce Commission alleging that the city of Shreveport was discriminated against, in that the interstate rates from Shreveport to certain Texas points were unreasonably high, and therefore these high interstate rates were prejudicial to Shreveport and discriminated against that city. Now, gentlemen of the committee, as we proceed in this discussion I would have you bear in mind all along the way that not one word of complaint was said against the Texas State rates. The case was submitted before the Interstate Commerce Commission on January 18, 1912, and on March 11 of that year the Interstate Commerce Commission, by a vote of 4 to 3, sustained the complaint and ordered the discrimination against the city of Shreveport removed.

Now, let us see what were the findings of fact by the Interstate Commerce Commission and what was its first order. First, it found that the city of Shreveport was discriminated against. Second (and if I misstate one word of

## ACCLIMATIZATION.

In continuance of the attempt undertaken four years ago to acclimatize the humpback salmon in eastern waters and to establish an annual run of that species in Puget Sound, 16,000,000 eggs which had been collected near Afognak, Alaska, were forwarded from that point during the fall of 1916. On arrival at Seattle, about half of the consignment was reserved for development at the Birdsvew, Quilcene, and Duckabush stations. The remainder of the eggs were shipped to Maine, arriving there November 17, and were divided between the Green Lake and Craig Brook stations. They were hatched at both stations with merely nominal losses, and the fry were distributed, in excellent condition, in the coastal rivers of Maine; points of deposit as near the headwaters of tributary streams as possible being selected for their liberation, the object being to guard against the destruction of the young fish by entrance into brackish water before reaching a suitable age. The eggs retained at the coast stations were also successfully hatched and planted.

A number of years ago the Bureau began the annual shipment of eastern lobsters to the State of Washington, in the hope of being able to establish this valuable crustacean in Puget Sound waters. In pursuance of this undertaking, a carload consignment of 6,420 adult male and female lobsters was forwarded from Bath, Me., to Anacortes, Wash., in November, 1916. This proved to be the most successful shipment of the kind that has so far been made, the total losses en route being less than 10 per cent. The lobsters, in excellent condition, were planted soon after arrival in the vicinity of Rosario, Orcas Island, one of the San Juan group.

In November, 1916, a lot of eyed eggs of the ayu, or dwarf salmon, which had been forwarded through the courtesy of the Japanese Government, was received at the Birdsvew (Wash.) station. These eggs, which are very small and somewhat adhesive, were transported in water. En route more than 50 per cent had hatched, and the fry, as well as most of the remaining eggs, were dead. The few live eggs hatched within a short time after being removed from the hatching boxes, but as the station had no equipment for handling such small fry, they quickly passed through the smallest mesh material available, and no opportunity was afforded to observe them.

## RELATIONS WITH THE STATES.

The Bureau's constant aim and practice are to cooperate with the fishery authorities of the various States in every feasible manner. This cooperation is most widely exhibited in the matter of providing fish eggs for incubation in the State hatcheries, the resulting young to be distributed under State auspices, and of furnishing young fish to be similarly planted.

A list of the States to which, on request, the Bureau, in 1917, supplied fish eggs and fish of the species and in the numbers indicated follows:

### ASSIGNMENTS OF FISH EGGS AND FISH TO STATE FISH COMMISSIONS, FISCAL YEAR 1917.

State and species.	Eggs and fry.	Fingerlings, yearlings, and adults.	State and species.	Eggs and fry.	Fingerlings, yearlings, and adults.
<b>California:</b> Chinook salmon.....	7,027,300	.....	<b>New Jersey—Contd.</b>		
<b>Illinois:</b>			Steelhead.....	100,000	.....
Black bass.....	.....	7,000	<b>New York:</b>		
Brook trout.....	50,000	.....	Lake trout.....	5,490,000	.....
Catfish.....	.....	10,500	Landlocked salmon.....	25,000	.....
Crappie.....	.....	300	Pike-perch fry.....	6,600,000	.....
Pike perch.....	15,000,000	.....	Steelhead.....	500,000	.....
Rainbow trout.....	50,000	.....	Yellow-perch fry.....	250,000	.....
Sunfish.....	.....	4,000	<b>North Dakota:</b>		
Whitefish.....	5,000,000	.....	Pike perch.....	3,000,000	.....
Yellow perch.....	.....	250	Steelhead.....	100,000	.....
<b>Indiana:</b> Pike perch.....	15,000,000	.....	<b>Ohio:</b>		
<b>Iowa:</b>			Lake trout.....	600,000	.....
Brook trout.....	50,000	.....	Pike perch.....	73,600,000	.....
Lake trout.....	100,000	.....	Whitefish.....	40,980,000	.....
Pike perch.....	40,000,000	.....	<b>Oklahoma:</b>		
<b>Kentucky:</b>			Black bass.....	.....	70
Black bass.....	.....	88	Catfish.....	.....	10
Chinook salmon.....	.....	6,000	Rock bass.....	.....	80
Crappie.....	.....	2,800	Sunfish.....	.....	90
Pike-perch fry.....	5,000,000	.....	Yellow-perch fry.....	100,000	60
Rainbow trout.....	.....	10,000	<b>Oregon:</b>		
Rock bass.....	.....	1,050	Blackspotted trout.....	250,000	.....
Sunfish.....	.....	4,200	Blueback salmon.....	2,000,000	.....
<b>Maine:</b>			Chinook salmon.....	163,900	60,000
Brook trout.....	100,000	.....	Lake trout.....	1,000,000	.....
Lake trout.....	200,000	.....	Silver salmon.....	.....	10,000
Landlocked salmon.....	401,000	.....	Steelhead.....	1,687,600	.....
<b>Massachusetts:</b> Catfish.....	.....	12,500	<b>Pennsylvania:</b>		
<b>Michigan:</b>			Lake trout.....	1,000,000	.....
Grayling.....	50,000	.....	Rainbow trout.....	50,000	.....
Lake trout.....	8,640,000	.....	Pike perch.....	8,000,000	.....
Pike-perch eggs.....	40,000,000	.....	<b>South Dakota:</b>		
Pike-perch fry.....	2,000,000	.....	Blackspotted trout.....	30,000	.....
Whitefish fry.....	250,000	.....	Brook trout.....	.....	23,150
<b>Minnesota:</b>			Pike perch.....	3,000,000	.....
Lake trout.....	3,300,000	.....	<b>Utah:</b> Blackspotted trout.....	.....	.....
Steelhead.....	200,000	.....	.....	100,000	.....
Whitefish.....	122,500	.....	<b>Vermont:</b>		
<b>Missouri:</b> Rainbow trout.....	98,400	.....	Channel catfish.....	.....	100
<b>Montana:</b>			Lake trout.....	1,600,000	.....
Black bass.....	.....	7,500	Landlocked salmon.....	40,000	.....
Blackspotted trout.....	400,000	.....	Steelhead.....	200,000	.....
Catfish.....	.....	2,000	<b>Washington:</b> Black-spotted trout.....	200,000	.....
Rainbow trout.....	150,000	.....	<b>Wisconsin:</b>		
Whitefish.....	300,000	.....	Lake trout.....	13,000,000	.....
<b>Nebraska:</b> Pike perch.....	9,800,000	.....	Whitefish.....	5,000,000	.....
<b>Nevada:</b> Brook trout.....	150,000	.....	<b>Wyoming:</b>		
<b>New Hampshire:</b>			Blackspotted trout.....	300,000	.....
Brook trout.....	50,000	.....	Lake trout.....	200,000	.....
Landlocked salmon.....	25,000	.....	Rainbow trout.....	100,000	.....
Rainbow trout.....	100,000	.....	Steelhead.....	100,000	.....
<b>New Jersey:</b>			<b>Total.....</b>	<b>a 322,930,700</b>	<b>163,248</b>
Rainbow trout.....	50,000	.....			
Smallmouth black bass.....	.....	1,500			

\* Includes 14,230,000 fry.

The Minnesota Game and Fish Department donated 25,000,000 pike-perch eggs which were consigned to the Duluth station.

#### CLOSURE OF FISH HATCHERIES.

During the year the Secretary, acting under the mandatory provisions of law, has closed two fish hatcheries, located at Havre de Grace, Md., and San Marcos, Tex. The Secretary's action in each case was based on the recommendation of the Commissioner of Fisheries, and no date was set for reopening the stations.

The conditions which necessitated the closing of the Battery shad hatchery at Havre de Grace, at the mouth of the Susquehanna River, are set forth in a report by the Commissioner to the Secretary on January 27, 1917, from which the following extracts are taken:

The possibility that the Bureau might be driven to this step has been appreciated by you for nearly four years. Each season in that period the condition of the fisheries at the mouth of the Susquehanna has been taken under consideration with reference to our fish-cultural work. In annual reports, in special reports to members of the legislature, in communications to the governor, in press notices to the fishermen and the general public, and in personal statements and appeals, we have shown the necessity for a radical change of policy on the part of the State of Maryland in order that the further depletion of once valuable fisheries might be arrested and the abundance of important food fishes might be restored and maintained. Nothing has been done to improve the situation. The State continues to permit practices known to be inimical to the best interests of the fisheries and directly antagonistic to the efforts of the Bureau of Fisheries in behalf of the people of the State. The future expenditure of effort and money under the circumstances is not only inadvisable and unjustified, but is clearly forbidden by the following stipulation which Congress has wisely placed on our annual appropriations for the propagation of food fishes:

"No part of the appropriation herein for propagation of food fishes shall be expended for hatching or planting fish or eggs in any State in which, in the judgment of the Secretary of Commerce, there are not adequate laws for the protection of the fishes."

The Government has been conducting shad-cultural operations at Havre de Grace since 1877, and has occupied the present site since 1880. Owing to its favorable location and the cordial cooperation of the fishermen, the hatchery was able to save the spawn of a very large percentage of the ripe shad caught for market, and the output season after season tested the full capacity of the plant. In fact, this hatchery has a record of young shad produced that is not approached by any other; and the abundance of fish was assured year after year, notwithstanding an enormous catch. Gradually the methods of fishing have undergone a change and there has arisen a new generation of fishermen apparently indifferent to the needs of the shad, forgetful of their own interest, disinclined to cooperate with the Government, and insisting on the use of methods that are contrary to the interests of the State and of its people. The legislature, with the weight of evidence and testimony available regarding the obnoxious fishing methods, would be justified in summarily suppressing them as a nuisance; they remain unaltered. There is thereby placed on the Federal Government a task that yearly becomes more difficult, more expensive, and more unsatisfactory to all persons having the welfare of the fisheries and the fishermen at heart.

In the earlier years cited, the average cost of collecting and hatching shad eggs at Havre de Grace was well under \$100 per million. In 1915 the cost exceeded \$1,940 per million, and during the past three seasons has averaged \$1,216 per million, or more than twelve times the former cost.

The entire history of the hatching operations on the Susquehanna shows that the Bureau has spared no effort and expense to aid the fisheries and maintain the supply of Maryland's most important food fish. I would favor the resumption of our operations as soon as the State gives evidence of a due appreciation of the Government's work by the enactment of laws placing proper restrictions on the fishing.

The situation at San Marcos was somewhat different from that at Havre de Grace in that two stipulations imposed by Congress in relation to the fish-cultural work of the Bureau were being violated. The matter was formally presented by the Commissioner to the Secretary in May, 1917, and the Secretary thereupon issued a closing order, accompanying it with a public statement from which the following is an extract:

It is with deep regret that I have been obliged to close the fish-cultural station at San Marcos, Tex., because of the failure of the State to meet the conditions imposed by Congress. These conditions are (1) that the State shall afford proper protection to the fishes cultivated and (2) that the Commissioner of Fisheries and his duly authorized agents shall be accorded the right to conduct fish-cultural work and all operations connected therewith in such manner and at such times as they may regard as necessary and proper.

The principal fish cultivated at the San Marcos station is the largemouth black bass, the most important of the fresh-water fishes of Texas. The Department has for



years been calling the attention of the State to the fact that this species is not protected during the spawning season, but may be caught and killed even when the parent fish are on their nest guarding their eggs and defenseless young. Such disregard for the elemental needs of the fish nullifies the work of the Bureau of Fisheries and indicates an indifference to the future welfare of the fisheries and fish supply that is in strong contrast to the attitude of other States. The necessity for amending the local fish laws was actively urged on the State by the Department during the years 1915, 1916, and 1917, is acknowledged by the State fishery officials, has been pointed out by numerous public-spirited citizens, and has received the favorable consideration of committees of the State legislature. At the recent regular and extraordinary sessions of the legislature strong representations were made to the legislature and the governor by citizens, by Department officials, and by members of the Texas delegation in Congress, but the legislature failed to act.

The other phase of this matter was (a) the assertion by the Bureau of the supposed right to take fish for brood purposes, rearing, and distributing, from the head of the San Marcos River, in accordance with a distinct agreement with the local utilities company, that controlled the water and with a citizens' committee which acted for the town of San Marcos, at the time the station was located there in 1893; and (b) the recent denial by the townspeople and the local legal officers of the right of the Bureau's agents to take fish from the shut-off head of the San Marcos River that, from the very outset, had been regarded as a part of the station's nursery system. Fortified by an opinion of the attorney general of Texas, the local county attorney gave notice that the continuance of operations in the water in question would be followed by prosecution of the Bureau's representatives. The Bureau could not consent to abandon operations it regarded as rightful nor to subject its employees to arrest, imprisonment, and possible fine and conviction, for carrying on disinterested work in behalf of the State, so the discontinuance of the station was the only logical procedure.

#### ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS.

The usual work in the propagation of fresh-water mussels was carried on at various points in the Mississippi Basin under the supervision of the fisheries biological station at Fairport, Iowa. By means of this work, together with well-regulated protective measures, it is expected to perpetuate the supply of commercial mussels.

During the year a total of 252,486,200 mussels in a condition of parasitism on fishes were planted in suitable waters, as compared with 331,451,490 for the preceding year. This decrease was due to very unfavorable river conditions and to an unprecedented scarcity of ripe mussels. While an abundance of female mussels with eggs was available, it was not until very late in the season that many "river muck-ets" sufficiently ripe for the work could be obtained.

Five species of commercial mussels were propagated in 1917, of which the principal ones were the common mucket and the Lake Pepin mucket. The inoculated fish hosts were liberated in the Mississippi River off Fairport and in Lake Keokuk, Iowa; in Lake Pepin, Minn.; in the Black and White Rivers in Arkansas; and in the Cumberland River in the vicinity of Kuttawa, Ky.

The actual cost of production was 2.72 cents per thousand, but if allowance is made for overhead charges the cost per thousand was 3.73 cents. In connection with this work 57,839 adult and 921,915 fingerling fish were reclaimed from landlocked ponds in the over-

flowed lands and returned to public waters. Of the number of fish rescued 110,603, or approximately 11 per cent, were infected with larval mussels. The total number of fish handled was 2,039,018.

The following table shows the details of this work:

MUSSEL PROPAGATION IN THE FISCAL YEAR 1917—POINTS OF DEPOSIT AND SPECIES OF GLOCHIDIA USED FOR INFECTION.

Species of mussel.	Cumberland River, Ky.	Arkansas.		Mississippi River.			Total.
		White River.	Black River.	Lake Keokuk, Iowa.	Lake Pepin, Minn.	Fairport, Iowa.	
Pocketbook ( <i>Lamprellis ventricosa</i> ).....						1,820,000	1,820,000
Mucket ( <i>Lamprellis ligamentina</i> ).....	4,669,000	15,432,700	34,072,500			76,806,500	131,009,700
Lake Pepin mucket ( <i>Lamprellis fuscula</i> ).....				12,639,900	106,662,600		119,302,500
Yellow sand-shell ( <i>Lamprellis anodonta</i> ).....		34,000				213,000	247,000
Butterfly ( <i>Plagiola securis</i> ).....		107,000					107,000
Total.....	4,669,000	15,573,700	34,072,500	12,639,900	106,662,600	78,838,500	262,486,200

## SURVEYS, INVESTIGATIONS, AND EXPERIMENTS.

### GENERAL ASPECTS OF THE WORK.

In biological work the year has been marked by substantial readjustments. These have arisen partly from enlarged responsibilities and opportunities coming with an increase of personnel, partly from the fact that some of the investigations have progressed to a stage justifying or requiring a rearrangement of plans, and partly from the conditions of national exigency. On the whole, the changes and the new undertakings have the effect of concentrating the efforts of the Bureau upon problems of most immediate practical importance.

The climax which came in national affairs late in the fiscal year necessitated the directing of the usual laboratory and field investigations toward increased production of aquatic supplies, especially foods, and toward measures that conduce to a reduction in wasteful and destructive practices.

### STUDIES OF MARINE FISHES.

The oceans, as the largest bodies of water, are and must always remain the greatest sources of food from fishes, and the studies intended to lay a proper foundation for the exploitation and control of marine fisheries are of very great importance. The conditions of study and the complexity of the problems are, however, of such a nature as to cause marine investigations to be relatively slow in the production of practical results. In the present circumstances, therefore, and with the lack of suitable available vessels, there has unavoidably occurred a temporary suspension of some investigations that it would have been otherwise highly desirable to continue.

The tuna investigation conducted off the coasts of southern California and Mexico has been continued throughout the year, with results which are not yet sufficiently definitive to admit of conclusions,

but which seem to indicate the delimitations of the areas of possible tuna fishery. At the close of the year plans were under consideration for a more adequate prosecution of this investigation in the hope and belief that another year would not pass without a definite and practical contribution to the solution of some of the principal problems now appearing as obstacles to a continuous and entirely successful prosecution of the tuna fishery and the industries dependent thereupon.

#### SURVEYS OF FISHING GROUNDS.

For a short period during the early winter of 1916-17 the *Grampus* was employed in surveying banks in the vicinity of Cape Fear of whose exact location, extent, and productivity the fishermen have been unaware. Unfavorable weather permitted the survey of but two grounds. The larger of these lies in 12 fathoms of water 9 miles southwest one-half south from the Cape Fear River entrance buoy, is easily found and will support an important fishery for sea bass or blackfish. The smaller ground, locally known as the "snapper bank," lies in from 12 to 13 fathoms of water 1½ miles west southwest from the offshore light buoy 2A at the end of Frying Pan Shoal. It is entirely surrounded by a large area of scattered patches of rock and affords good fishing when a vessel is allowed to drift over it.

The investigations of the same vessel in the Gulf of Mexico later in the winter, although seriously interrupted by storms, fog, and other circumstances, yielded information valuable to the fishery interests of Alabama, Mississippi, and Louisiana. Shrimp were taken in abundance in the otter trawl on mud bottom, in 5 fathoms of water, off the entrance to Mobile Bay. In February experimental hauls off the southeast side of Ship Island, Miss., developed a productive area at least 4 or 5 miles long on which shrimps were found in abundance equal to the best fishing off Fernandina, Fla., but with a much smaller proportion of small fish and trash. Another ground producing large shrimp in abundance was found in 9 fathoms, on mud bottom, about 9 miles southeast of Barataria Pass, La. These results indicate that a productive winter fishery for these valuable crustaceans may be developed offshore on a considerable stretch of the Gulf coast.

#### OCEANOGRAPHY.

The same causes which have contributed to a temporary diminution of activity in studies of marine fishes led before the close of the year to the interruption of some of the important oceanographic investigations.

The *Grampus* was, however, able to make a series of observations beginning with a cruise from Gloucester, Mass., to Norfolk, Va., early in the fiscal year. The vessel then made a line of hydrographic stations from Cape Henry to the Gulf Stream and thence to Cape May, N. J. Going later to Gloucester, Mass., a few stations were made in the Gulf of Maine, whence she proceeded to Southport, N. C., for investigations of fishing grounds as already mentioned, and later to Key West. In the Gulf of Mexico the vessel cruised over the continental shelf (within the 100-fathom line) from Key West, Fla., to Aransas Pass, Tex.

Some oceanographic data have also been gathered in connection with the tuna investigation on the Pacific coast.

While the field work in the investigation of Chesapeake Bay closed during September, 1916, the detailed study of materials collected, which is necessary for the drawing of conclusions, remains to be finally completed; however, substantial progress has been made.

#### SHELLFISH INVESTIGATIONS.

Provided with a more adequate personnel for attention to the problems of the oyster industry, the Bureau has been able to set these investigations upon a basis promising and already yielding greater efficiency and more practical service to the oyster industries. A provisional field laboratory has been established at Milford, Conn., from which as a base the principal problems of the great oyster-planting industry on Long Island Sound and other waters are being considered. The problem of finding the conditions necessary to secure a regular "set" of oysters is given first place, although attention is given from that headquarters to other important matters, such as the destruction or damaging of oyster beds by the growth of the so-called "sand coral."

There has been cooperation with the Conservation Commission of Maryland in observational and experimental work on the growth of oysters in Chesapeake Bay. Through the Woods Hole laboratory further attention has been given to the study of green gill in oysters of Lynnhaven Bay and other localities, and studies of some importance have been addressed to the nutrition of oysters. The results of both of these latter investigations have been given out in published reports. The Bureau has continued to extend aid to the oyster investigations of Puget Sound undertaken in cooperation with the University of Washington.

Serious mortalities among oysters or injuries to oyster beds occurred during the year in regions remote from each other and from distinct causes in the several cases. Among these was the damage to oyster beds from "sanding," owing to the work of polychæte worms in building tubes of sand and overrunning, or even smothering, the oysters; it was most prevalent in Jamaica, Great South, and Hempstead Bays. The loss of large numbers of planted oysters in Chesapeake Bay was investigated and the results were made known to persons interested. On the west coast of Florida there occurred very serious losses of oysters resulting from the depredations of a turbellarian worm, locally but improperly known as a "leach." A less misleading and more appropriate name is that of "wafer," which is applied to a similar pest in New South Wales. This form had not previously been recorded as an enemy of oysters in this country.

Mortality among scallops in Maine was investigated and found to be attributable to the work of starfishes, which were made more abundant by the pursuit of improper practices in the scallop fishery. Appropriate recommendations were made.

Investigations relating to fresh-water mussels have been continued actively. Interesting progress has been made in experiments in rearing mussels under conditions of control since it has been found that mussels (Lake Pepin muckets) reared in confinement from artificial infections begin breeding at the age of little more than two years. A second generation is now being reared from parents which

were artificially propagated and reared in confinement. Studies and experiments indicate that the natural food of fresh-water mussels is made up principally of detritus, which is decayed or decaying animal and vegetable matter, and that vegetable matter is preferred to animal. Investigations completed just at the beginning of the fiscal year have shown also that fresh-water mussels have the power of absorbing nutriment in the form of fats (olive oil) and protein (egg albumen) directly from solution in the water and through the cells of the surface of the body (gills, mouth, palps, and foot). It was possible to determine that the fats, so taken up by the cells of the outer body walls, were transported through the circulatory system to the various parts of the body.

Considerable attention has been given to the matter of securing for the mussels proper protective legislation on the part of the several States. Under present conditions, the efforts of the Bureau to propagate fresh-water mussels are not supplemented as they should be by the extension of a reasonable measure of protection to the young mussels.

A study of the causes of pearl formation in fresh-water mussels has been brought to a stage of reporting. There has also been obtained during the year a valuable fund of information regarding the pearl fisheries and pearl culture in the Far East to which it is hoped to give publication within a reasonable time.

#### BIOLOGY OF THE BLUE CRAB.

A new investigation of the life history and habits of the blue crab, although begun only at the beginning of the fiscal year, has already made such progress as to supply the information most needed as a basis for the regulation of the fishery and the conservation of the blue crab, particularly in Chesapeake Bay, the headquarters of the world's greatest crab fishery.

The blue crab may spawn more than once. Crabs under observation have spawned twice in the same summer. The female crabs which are dredged during the winter are prospective spawners whether or not they have spawned during the preceding season. The life history of this species in Chesapeake Bay is, in brief, as follows:

Nearly all the young are hatched in the lower bay from the last of June to about the first of September. The great majority of the young begin a migration northward up the bay, settling on the bottom when cold weather comes and ceasing to feed or to shed. The next spring they resume development and their northerly migration. They reach maturity in Maryland waters, where mating occurs, principally during the last of July and August. Mating occurs only once during the lifetime of the female, but sufficient sperm is received and carried to fertilize two or more successive batches of eggs. The females then migrate southward to the lower part of the bay, while the males generally stay behind, spending the winter in deep water or in creeks and rivers. About 80 per cent of the adult crabs taken in the upper waters of the bay are males, and, correspondingly, about 80 per cent of the adult crabs taken in the waters near the mouth of the bay are females.

Some of the females lay a batch of eggs before or while going south, but probably the greater number lay no eggs until the following season. A certain small percentage of the young do not migrate up the bay but remain to develop and mate in the lower waters.

At the approach of cold weather the crabs settle to the bottom and are usually supposed to bury there, but it is probable that they simply lie dormant and occasionally move slowly over the bottom. Practically all females dredged during the winter, whether or not they had spawned previously, were found to contain eggs and the live sperm with which to fertilize them. There is no evident northward migration of such crabs in the spring. Most of the females die shortly after the last batch of eggs is laid. Crabs mature in about a year, growing in size by successive moltings. Mating occurs only at the last molt of the female, when the abdomen changes from the triangular to the apron form. The length of life is apparently two or three years.

An investigation of the spiny lobster, an important crustacean and excellent article of food in the waters of southern Florida, was undertaken about the middle of the fiscal year, and satisfactory progress is being made.

#### PROGRESS IN CULTURE OF DIAMOND-BACK TERRAPIN.

The results of the continued experiments in diamond-back terrapin culture at the Beaufort (N. C.) laboratory were given at some length in the last annual report. The progress during the past year has been gratifying, especially in the rapid growth of the young terrapin hatched in the summer of 1916. The largest individual kept in a warm house and fed during the winter was more than three inches (80 mm.) in length of bottom shell. This is believed to be a new record for the growth of diamond-back terrapin in the first year of life, and gives further encouragement to terrapin culture as a commercial enterprise.

#### STUDIES OF ANADROMOUS FISHES.

At the beginning of the fiscal year, two particularly important investigations were in progress relating to fishes which, though not alike in structure or appearance, have the same interesting and significant habit of leaving the ocean and ascending streams for the purpose of giving rise to a new generation. This habit is of particular practical importance because essentially all the mature individuals of the species are periodically assembled in definite runs in restricted localities, when they are easy of capture on the one hand and available for purposes of artificial propagation on the other. It is most desirable that there should be available specific and reasonably complete knowledge of the migrations of the shads and the salmons and of the conditions to be met in protective measures and in practices of artificial propagation.

Progress was made in the analyses of the data accumulated during the field studies on the principal shad streams from St. Johns River, Fla., to the St. Croix River, Me., and New Brunswick, but probably no stage of completion can be reported until, with a change of conditions, it becomes again possible to give the careful attention to the elaborate measurements, comparisons, and analyses which the subject requires.

A further investigation of the migrations of the Pacific salmon has been undertaken with the most competent assistance, having special reference to the salmon of Alaska and the problems of governmental and private artificial propagation.

#### INVESTIGATIONS PERTAINING TO FRESH-WATER FISHES.

The Bureau has continued actively the several investigations relating to the food of fresh-water fishes, both as independent studies and as phases of the experiments in the rearing of fishes in ponds. The results of more than two years of study of the habits and food of the yellow perch have been prepared for publication. A report on the pikes, comprising most of the known data regarding the habits, artificial propagation, and commercial importance of this well-defined family of fishes, has been issued and will prove useful to those who are interested in the cultivation of the pike, pickerel, and muskellunge, and to whom it is of importance to understand the relations of these predatory fishes with their less vigorous associates in natural or artificial bodies of water.

The serious decline in important fisheries of the Great Lakes, due to excessive and sometimes unrestricted fishing, long ago showed the necessity for a thorough knowledge of the habits and migrations of the principal fishes of the Lakes, in order that the regulation of the fishery and the artificial propagation of the fishes might be founded upon such a clear understanding of the habits and movements of the fishes that the maximum in practical results would be attained. It has not yet been possible to give to this field attention commensurate with the importance of the fisheries and the difficulties of the problems. A beginning was made during the fiscal year in the inauguration of a new study of the systematic relations, habits, and migrations of the fishes of the subfamily *Coregoninæ*, including the whitefishes and ciscoes or lake herring.

The experiments and investigations in the rearing of fishes in ponds, which have been pursued in connection with the fisheries biological station at Fairport, Iowa, have continued to yield gratifying results. While the artificial propagation of the buffalofish had previously been shown to be entirely feasible as regards the fertilization and subsequent handling of eggs and the rearing of young to a fairly advanced stage, the effort to have buffalofish spawn naturally in artificial ponds had not, until the spring of 1917, met with success. The conditions were varied last season by keeping the experimental pond about half full of water in the early part of the season and allowing it to fill gradually early in May. A few days after the pond was filled, a few buffalofish were observed to be "splashing" along the margin of the pond. Abundant buffalofish fry were observed soon afterwards, when specimens were collected and identified. Without additional experimentation it can not be definitely determined if the manner of manipulation of the pond practiced this season was the particular effective factor in bringing success.

In the last annual report it was mentioned that, in spite of many failures in earlier trials, a successful attempt at the propagation of the channel catfish, or spotted catfish, in ponds was in progress as the fiscal year closed. As the channel catfish at Fairport have again spawned under observation in the ponds of Fairport, it seems alto-

gether probable that this most highly esteemed of all catfishes can be propagated successfully in a practical way, by providing a suitable environment and proper nesting conditions, and by the exercise of care to separate the adults from the eggs or young at the proper time. The fry which hatched in the ponds and those which were hatched from eggs in jars in the experimental battery grew rapidly, attaining a length of 3 inches in a few weeks.

Other experiments in the propagation and rearing of the largemouth bass and several species of sunfishes have also been in progress.

In experiments in the rearing of fishes attention has been given to the study of the food of the developing fishes at all stages, and to collateral observations of the available food supply. Experiments have also been undertaken in the artificial feeding of fishes in ponds.

During the fiscal year a careful biological and fish-cultural survey of certain waters of western North Carolina, including the Mount Pisgah National Forest Reserve, was made and information was gained that will be of material value in guiding the Government's activities in the propagation and protection of fishes in the reservation.

The fish capacity of artificial ponds or of natural lakes is determined by physical, chemical, and biological conditions, and success in the rearing of fishes or the conservation of fishes will be greater if guided by a proper knowledge of these interrelated conditions. The subject is one of much complexity and knowledge grows only by slow stages and patient application. The Bureau has been glad, therefore, to continue its cooperation with the State Geological and Natural History Survey of Wisconsin, in those fruitful studies of the biological and physical conditions in Wisconsin lakes which have a general application.

In the study of the fishes in relation to the extermination of mosquitoes and to public health, as supplemental to the broader investigations and activities of the Public Health Service and the Bureau of Entomology, a satisfactory degree of progress has been made and further experiments are undertaken in promoting a growth of desirable species of fish in impounded waters.

#### WATER-POWER DEVELOPMENT IN RELATION TO FISH LIFE.

With progress in water-power developments and a steady increase in the number of dams in the course of rivers frequented by migratory fishes, it is unfortunate that there is not more adequate information as to the conditions under which fishways are necessary and practicable and the types of fishways adapted for particular species of fish and conditions of stream and dam environment. As much attention as possible has been given to the matter during the fiscal year and a report on the subject was issued. Plans are in contemplation for more extended field studies during the fiscal year 1918.

The peculiar problems of fish protection in arid regions arise from the fact that large portions of the flow of streams may be diverted into irrigation canals, and, if the fish are permitted to pass freely through the canals and into the laterals, they must eventually be stranded in the fields or otherwise lost. An investigation of the conditions in irrigation projects was begun last winter, and a preliminary report on the subject has been made. The investigation has been interrupted for a time by the pressure of other matters.



At the Yuma (Ariz.) project the fish are excluded from the canals, because of an arrangement whereby the water enters the canals from a settling pool through a siphon that is fish tight. Seven miles below Yuma the maintenance of a dam on the Colorado River for diversion of water in Imperial Valley, Cal., causes the river bed below the dam to be left dry at times so that quantities of fish are stranded. The Salt River project involves a large system, but as the canals and ditches always contain water there is little reason to suppose that much damage to fish occurs. The reservoir formed by the construction of the Roosevelt Dam in Arizona has been well stocked with bass. Fish are reported to be lost in the spring freshets, when the water rises to a height of 10 feet or more above the top of the spillways, carrying fish over the dam and through a fall of 225 feet. The prevention of such losses by the use of screens to hold the fish back has been given consideration, but the difficulties are very great and possibly insurmountable.

In California, and especially in the Sacramento River basin, where large areas of land are farmed by irrigation, large losses of fish would occur but for the effective work of the State authorities in requiring all ditches and intakes to be provided with screens and all dams with fishways. A recent act of the legislature requires the owners of dams that are too high for a useful fish ladder to build and maintain hatcheries. In that State the "squirrel-cage" type of revolving screen is generally recommended for its simple design and cheapness of construction, but for canals wider than 25 or 30 feet the parallel-bar type of screen is considered the only practical means of keeping fish out. In Nevada a new law effective September, 1917, requires the screening of intakes and ditches as well as the use of fishways. Irrigation is extensively practiced in the northern half of the State, and heretofore countless numbers of trout fry and other fishes have been poured into the fields.

#### SERVICE OF THE BIOLOGICAL LABORATORIES.

The various investigations in progress at the several biological laboratories at the close of the preceding fiscal year were continued during the early part of the present year. Before the close of the year, however, it was found desirable to adopt temporarily a new policy with regard to the laboratories because of the necessity of concentrating all efforts, as far as possible, upon the immediate increase of the aquatic food supply.

The laboratory at Woods Hole was not opened for general investigations but a special staff was stationed at that laboratory for work relating to the improvement of methods of preserving fish. One investigator was employed for observation of the occurrence of nematode parasites in the flesh of marine fishes, a question which has been found to have a direct bearing upon the marketing of fish.

At the Beaufort laboratory the scientific staff consisted only of the director and one investigator who was enabled to continue the important and timely investigation of the protection of wood against marine borers. The director devoted himself to experiments in the curing of fish by methods of salting and of salting and smoking. It had been generally believed that the curing of local fishes during the summer was not practicable, but, largely as a result of the Bureau's

efforts and experiments, several kinds of fishes have been preserved and the dealers have found a good demand for salted fish.

The fish-cultural experiment work of the fisheries biological station at Fairport bears so directly upon the immediate problems of food supply that the activities of this station have suffered no curtailment, but are expected to be somewhat extended during the ensuing year. Among the investigations in progress, apart from the direct experiments in rearing fishes as previously referred to, are those relating to insects and insect larvæ, aquatic plants, and parasites, as they affect the productivity of ponds or lakes. The results so far obtained are already valuable in guiding the management of fishponds.

The construction of the marine biological station at Key West was undertaken during the fiscal year. The pool which will serve as a source of supply for sea water, for the protection of small boats, and for other purposes, has been excavated, and a canal connecting the pool with the ocean has been completed except for a control gate. Plans for two of the buildings were completed and bids were advertised for in the last month of the year. Owing to various causes, including the present high prices of labor and materials, there exists some doubt if a reasonable bid will be received. Meantime, some scientific work was begun during the winter and encouraging progress has been made. The study of the spiny lobster has been the principal investigation.

#### MISCELLANEOUS INVESTIGATIONS AND SERVICES.

There has been an unusual number of calls upon the Bureau for investigations and advice relating to the diseases of fishes or to the mortality of fishes in public or private waters, due either to disease or to industrial pollutions. In as many cases as possible the fish pathologist of the Bureau, or an assistant, has visited the scene of trouble, made all practicable observations or collections, and upon return to the office has subjected the material and data to careful examination. The most serious trouble of this kind to arise was a mortality of sea fishes on the west coast of Florida, which has been described and discussed in a published report.<sup>a</sup> Other serious troubles manifested themselves in Chesapeake Bay, Saginaw River and Bay, and elsewhere.

The Bureau has not only continued to cooperate with the Bureau of Soils, as far as the conditions permitted, in a study of kelp harvesting in relation to the fisheries, but it has begun a systematic study of the distribution of marine algæ on the west coast with particular attention to species that may be useful in the industries.

#### ALASKA FISHERIES SERVICE.

##### IMPORTANCE OF THE ALASKA FISHERIES.

All branches of the fishing industry, except whaling and halibut fishing, showed an increase in 1916 over 1915, and the fisheries in the aggregate were more extensive and valuable than ever before. The number

<sup>a</sup> Mortality of Fishes on the West Coast of Florida. Appendix III, Report of Commissioner, 1917; by H. F. Taylor. Bureau of Fisheries document No. 848.

of persons engaged was 23,994, an increase of 1,532 over the previous year; the investment amounted to \$39,569,612, an increase of more than \$2,253,000; and the value of the products was \$26,156,559, an increase of more than \$5,157,000. The yield of the fisheries in both quantity and value was the largest in the history of Alaska. The record year, 1914, was surpassed by nearly \$5,000,000 in the market value of the output.

The salmon industry in 1916 represented 88 per cent of the total investment in Alaska fisheries and 92 per cent of the total value of products. An important feature of the business was the operation of 100 canneries, a gain of 15 over 1915. The pack of canned fish reached the stupendous total of 4,900,627 cases, valued at \$23,269,429, which figures were never before equaled. In southeast Alaska, the runs of coho and chum salmons were the largest ever known, and the runs of humpback and red salmons were exceeded only by the seasons of 1915 and 1914, respectively. In central Alaska there were exceedingly heavy runs of humpbacks and reds, and the fish canned exceeded by 400,000 cases the high record of 1914. In western Alaska, the district in which the red salmon predominates, the catch of 19,600,000 fish was but little less than the average for the five-year period ending with 1916 and was about 3,000,000 fish more than in 1915.

The other important Alaska fisheries in 1916 had the following value of products: Halibut \$679,463, cod \$518,797, herring \$418,076, and whale \$363,721. As compared with 1915, the halibut and whale fisheries showed a decline and the cod and herring fisheries an advance.

#### VIOLATIONS OF THE FISHERY LAWS.

Taking into consideration the immense extent of the fisheries, the vast territory covered by the operations, the comparatively unsettled condition of most of the coastal sections, and the strong temptations that come to the fishermen to take fish regardless of the welfare of the industry, serious violations of the fishery laws are remarkably infrequent.

During the 1916 fishing season a number of cases of minor infraction of the laws were reported by the Bureau's agents to the local United States commissioners and district attorneys. These cases involved fishing during the weekly close period, fishing in prohibited areas, and using nets within illegal distance of other nets. In most instances conviction was secured and a fine was imposed. A noteworthy batch of cases was brought before the United States commissioner at Haines in August, 1916. The Bureau's warden made complaint against the operators of 3 boats and 28 operators of nets, found fishing in Chilkoot River and Chilkoot Lake in violation of the weekly close-time provision of law. All of the defendants pleaded guilty and were fined from \$1 to \$250 and costs.

#### CENSUS OF WOOD RIVER SALMON.

Wood River, a tributary of Nushagak Bay, has for many years been set aside as a natural breeding preserve for salmon, chiefly resorted to by the red salmon. In order to keep informed as to the extent to which the salmon are able to escape the commercial fishing operations in Nushagak Bay and pass up Wood River to their spawn-

ing grounds about Lake Aleknagik the Bureau in 1908 began the enumeration of the fish and has continued this work each year since, 1914 excepted. By means of a temporary rack thrown across the stream near the lake, the fish are compelled to pass through a narrow gate and are there counted by agents kept continuously on duty, by day and night, for about seven weeks during which time the run lasts.

In 1916, between June 23 and August 12, the number of salmon ascertained to have gone to their spawning grounds was 551,959, compared with 259,341 in 1915. The bulk of the fish came in three distinct waves in July, at the crest of which 57,237, 47,343, and 55,864 salmons, respectively, were noted in 24 hours. Except during the heavy runs a considerable proportion of the fish showed injuries attributable to nets, and such fish were somewhat more numerous than in 1915.

Acknowledgments are due to several fishing companies for assistance which made this work possible. The Alaska-Portland Packers' Association provided a tug for towing the equipment to the lake. The Alaska Salmon Co. supplied a boat for use in making investigations on the lake and the Alaska Packers Association furnished the entire equipment required for making the count.

#### A FISHERY INTELLIGENCE SERVICE FOR ALASKA.

In response to a formal request by the Territorial Legislature of Alaska, the Bureau of Fisheries in conjunction with the Signal Corps of the United States Army established (in the summer of 1917) a fishery intelligence service whereby a number of coastal towns in Alaska are furnished daily (Sundays and holidays excepted) with the prices of fishery products at Seattle and Ketchikan. The daily quotations include the prices of the more important kinds of fresh fish, and on Monday of each week additional information is furnished in regard to prices of salt products at Seattle and Ketchikan. It is hoped that the service thus afforded the public will tend to stabilize prices and to create a more dependable market for the fishermen's products.

#### COMMERCIAL FISHING WITHIN THE ALEUTIAN ISLANDS RESERVATION.

During the past fiscal year 11 permits to engage in fishery operations within the Aleutian Islands Reservation were issued to the following persons and companies:

1. S. Applegate, of Berkeley, Cal., authorizing the packing of not to exceed 300 barrels of salmon per annum in the vicinity of Umnak Island.
2. A. C. Goss, of Unalaska, authorizing the taking of atka mackerel and red salmon in the vicinity of Attu Island and Umnak Island, respectively, in 1917.
3. Pacific American Fisheries, authorizing the construction and operation of a plant on Ikatan Peninsula for the canning or salting of salmon or other food fishes.
4. Sockeye Salmon Co., authorizing the construction and operation of a plant on Unimak Island for the canning or salting of salmon or other food fishes.

5. Paul Buckley, of Unalaska, authorizing him to engage in cod fishing operations on Akutan Island.

6. Paul Buckley, authorizing him to engage in cod fishing operations on Unalaska Island.

7. Alaska Fishing Co., authorizing the taking of not to exceed 1,000 barrels of salmon in the vicinity of Unalaska Island in 1917.

8. Paul Buckley, authorizing him to construct and operate on Unalaska Island a plant for the canning or salting of salmon and other food fishes taken in the vicinity of Unalaska Island.

9. O. K. Quean, of Unalaska, authorizing him to take not to exceed 200 barrels of salmon in the vicinity of Unalaska Island in 1917.

10. Alaska Commercial Co., authorizing the packing at Unalaska of not to exceed 50 barrels of salmon in 1917.

11. Andrew C. Smith, of Portland, Oreg., authorizing him to engage in the business of salting cod and salmon for commercial purposes at Chernofski Harbor and Kuliliak Bay.

All of these permits stipulate that employment shall be given as far as practicable to natives of the reservation in the matter of carrying on the operations authorized. All permits are revocable at the pleasure of the Secretary of Commerce.

Two permits authorizing operations within the Aleutian Islands Reservation have been issued jointly by the Departments of Commerce and of Agriculture. One involves the pasturing of cattle, sheep, and other domestic animals by Paul Buckley upon that part of Unalaska Island which is south and west of Kashega and Kuliliak Bays; the other somewhat similar operations on Umnak Island by Andrew C. Smith.

#### INSPECTION OF PRIVATE HATCHERIES.

In the year 1916-17 there were operated in Alaska four salmon hatcheries belonging to companies engaged in the catching and canning of salmon. These obtained 90,136,000 eggs of the red salmon, and hatched therefrom 83,353,000 fry which were planted in local waters. Under the law the rebates of taxes allowed these companies, amounting to 40 cents for each 1,000 red or king salmon fry released, aggregated \$33,341.

#### STREAM IMPROVEMENT.

An important matter in the conservation and increase of the salmon supply in Alaska is the improvement and development of additional natural spawning beds. There are numbers of streams in Alaska, particularly in the southeastern section, which are impassable to salmon because of natural barriers, chiefly waterfalls. In some cases, also, streams have become choked through the accumulation of timber and other débris. It is felt that much good may be accomplished by giving the salmon every possible opportunity to spawn naturally. There are various places where falls can be blasted out or where fishways can be established, thus opening up a considerable extent of spawning area which heretofore has been wholly inaccessible to salmon or which in some instances has been accessible only at periods of high water. The Bureau feels that at comparatively small expense excellent work can be done in bettering

these conditions. A few streams were improved in this way during the past year, but the work has been limited because of a lack of funds. It is hoped that these operations can be undertaken on a more extensive scale in the near future.

### ALASKA FUR-SEAL SERVICE.

#### SEAL ISLAND NATIVES.

The welfare of the native inhabitants of the Pribilof Islands is a matter demanding and receiving the constant solicitude of the Bureau. The attitude of Congress toward these people, as shown by the safeguards thrown around them and funds provided for them, has resulted in the gradual development of a community that is probably better cared for than any other natives of Alaska.

On June 30, 1916, the resident natives numbered 311 (192 on St. Paul and 119 on St. George Island), and on March 31, 1917, they numbered 316 (193 on St. Paul and 123 on St. George). The population remains nearly stationary, the fluctuations in recent years not exceeding 2 or 3 per cent. The general health of the natives has continued good. The physicians and the school-teachers, acting under the immediate direction of the agents, deserve much credit for their work in improving sanitary conditions among the natives and for their efforts to raise the standard of living.

A full account of the measures taken for the support of the natives, their education, and their physical care is given in the report on the Alaska service for the calendar year 1916.

The act making appropriations for the Bureau for the fiscal year 1917 contained an item of \$20,000 for new buildings, repairs to old buildings, and other necessary improvements on the Pribilof Islands. The appropriation became available too late to permit the purchase and transportation of materials in the season of 1916. Accordingly, the work of planning for the most important constructions and repairs was taken up in the winter of 1916-17, and a large quantity of building material was sent to the islands in July, 1917, on the steamer *Roosevelt*. The matters to which special attention has been given during the present season, in addition to general repairs to existing structures, are (1) the construction of new houses for natives on both islands, (2) the construction of a new salt house on each island for use in preserving and storing sealskins, (3) the installation of a new water-supply system for the village on St. George Island, (4) a survey for a new water-supply system for the village on St. Paul Island, and (5) important sanitary improvements on St. Paul Island.

Careful consideration has been given to the type of house that would be most suitable for natives. The houses now occupied were built for the most part 40 years ago, and are small, uncomfortable, and insanitary. Final choice has been made of a neat, simple knock-down house, plans for which were submitted by a Seattle firm, comprising a living room, three bedrooms with closets, a kitchen, and a bathroom, all on one floor. Four such houses for St. Paul Island and two for St. George Island have thus far been provided.

The large quantities of supplies annually required for the support and use of the natives, and of the Government employees on the

islands, together with the materials needed in connection with the taking, curing, storing, and shipping of seal and fox skins, were, for the season of 1917, sent to the islands on the steamer *Roosevelt*. This is the first time that the Bureau has been able to employ its own vessel for this service.

#### APPROPRIATIONS FOR SEAL SERVICE.

Owing to the increased cost of supplies it became necessary to devote a larger part than heretofore of the appropriation of \$75,000 for the fiscal year 1917 to the Pribilof Islands. During the second half of the fiscal year the Bureau was forced to limit greatly or altogether suspend certain activities of the work pertaining to the protection of the fisheries and the minor fur-bearing animals. Congress has made the same appropriation, namely, \$75,000, for the entire Alaska service for the fiscal year 1918. In the season of 1917 there was a still further increase in the cost of supplies, as was evidenced by the return of proposals submitted in May, when the aggregate amount was found to be approximately \$72,000. Steps were, therefore, taken to secure a supplementary appropriation. Inasmuch as the Bureau is charged with the support of the natives on the Pribilof Islands, it feels that its first duty is to purchase the needed supplies for that purpose. Unless Congress meets this emergency, the work of the Alaska service in regard to the protection of the fur-bearing animals and fisheries must perforce be so curtailed and limited as to be seriously ineffective.<sup>a</sup>

#### CONDITION OF THE SEAL HERD.

A detailed statement of the condition of the Alaskan seal herd in 1916, with various tables and comparisons with former years, is contained in the report entitled, "Alaska Fisheries and Fur Industries in 1916," published in August, 1917 (Bureau of Fisheries document No. 838, 118 pages). The usual complete census, conducted by G. Dallas Hanna of the Bureau's staff, showed 417,281 seals of all ages in the herd in the summer of 1916, an increase of 14.6 per cent over 1915. Tentative figures of the census of 1917, also under the direction of Mr. Hanna, indicated a total of 468,692 animals of all ages. The estimated number of pups born in the summer of 1917 was 128,024, as against 116,977 in 1916.

These increases in the seal herd resorting to the Pribilof Islands are regarded as entirely satisfactory and such as are to be regularly depended on so long as the present conditions prevail. The recuperation of the herd to something like its former proportions within a comparatively few years may confidently be expected. The natural mortality among the various classes is now normal; and the only untoward feature of the present situation is that arising from the great preponderance of mature and adolescent male seals as a result of the close-time that has been effective for five years and expired on August 24, 1917. It should be the consistent policy of the Bureau, as it is its obvious duty, in the light of the established biological facts and economic demands, to so administer the seal herd as to overcome the existing disparity of male life and to ultimately bring the herd to a condition approaching that of a scientifically managed herd

<sup>a</sup> Congress has since appropriated an additional sum of \$35,000 for the Alaska service for the fiscal year 1918.

of dairy cattle, where every young female born will be saved and reared and every young male not actually required for breeding purposes will be otherwise utilized in the most profitable manner.

#### SEALS REQUIRED BY SEAL ISLAND NATIVES.

The quota of seals whose meat was needed for food by the natives of the Pribilof Islands was tentatively fixed at 7,500 for the calendar year 1916. The number actually taken and utilized, including the few seals which died during the drives, was 6,468, of which 3,483 were from St. Paul Island and 2,985 from St. George Island.

For the calendar year 1917, which up to and including August 24 was subject to the close-time law fixed by Congress, the food requirements of the natives were regarded as the same as in 1916, although it was of course contemplated that a part of those requirements would be met by the seals taken for commercial purposes.

#### SALE OF SEALSKINS.

During the fiscal year 1917 there were three public-auction sales of skins taken from the seals that had been killed for the use of the natives. These sales were conducted at St. Louis by Messrs. Funsten Bros. & Co., agents of the Department, and consisted of skins that had been received during several years, there having been no attempt to dispose of sealskins in the fiscal year 1916 owing to the condition of the market. The details of the sales are as follows:

Date.	Skins.	Gross prices received.	Net prices received.	Average gross price per skin.
	<i>Number.</i>			
September 20, 1916.....	1,900	\$74,530.00	\$52,063.26	\$30.23
January 29, 1917.....	2,000	93,678.00	65,450.27	46.94
April 18, 1917.....	1,500	68,540.50	48,259.65	45.09
Total.....	5,400	236,748.50	165,793.18	43.94

All of the foregoing skins were dressed, dyed, and machined before being offered for sale, and were thus ready to be made into garments. This is the newest feature of the sealskin industry as established in America by the Department. The financial results have been such as to fully justify the agreement whereby the Government paid \$10 apiece for the skins thus treated, and the buyers have expressed great satisfaction that they were able to obtain finished goods, whereas under the conditions formerly prevailing they would have been obliged to undergo the delay, the uncertainty, and the greatly increased expense of having their raw skins shipped to London and reshipped to America before any use could be made of them. It is impossible to state just what monetary benefit the Government has derived from this arrangement, but some data afforded by the April sale were very suggestive. On that occasion there were sold at public auction, under the same conditions that attended the sale of 1,500 dyed and dressed Alaskan skins, 1,553 raw skins taken from the Robben Island seals under the supervision of the Japanese



Government; the Japanese skins were of essentially the same quality as the Alaskan, and whereas the former brought on an average \$25.84 per skin, the latter, as already stated, brought \$45.69 per skin, an increase of \$19.85.

All branches of the fur-seal industry have thus become firmly established in America through the action of the Department, and not only Alaskan skins but skins from seal herds in the custody of other governments are finding their market here.

#### BRANDED SEALS.

The 5,228 fur-seal pups branded on the Pribilof Islands in 1912 have continued to afford valuable data bearing on the relation of age to size and growth. These data supply the most authentic and only conclusive evidence on this much-discussed subject.

During the season of 1916 numbers of these branded seals—both male and female—were observed in drives and on the rookeries. On St. George Island, in the period from June 9 to August 10, 1916, there were noted in various drives 198 male seals bearing the 1912 brand and therefore 4 years old; 30 of these were taken for accurate measurement. Branded seals were noted in nearly every drive of bachelors and in considerable numbers among the cows in the harems. On St. Paul Island 44 branded males were taken for examination. The foregoing examples were included in the 1916 shipment of skins and were classified by the experts in St. Louis as follows, the designation being in accordance with the long-established and universally recognized London standard:

	Number.
Small pup.....	2
Middling pup.....	4
Large pup.....	22
Small.....	27
Middling.....	4
Middling and small.....	15
Total.....	74

The variations in the size of seals of the same age are clearly shown in this statement. The 74 skins from seals known to be 4 years old fall into six trade categories, with "large pup" and "small" predominating. The trade names applied to sealskins have come to mean so little and are so misleading that a new classification would seem to be demanded.

#### UTILIZATION OF WASTE PRODUCTS OF THE SEALING INDUSTRY.

With the exception of limited quantities of seal meat required by the native inhabitants of the Pribilof Islands, practically the entire carcass of the fur seal after the removal of the skin has up to this time been discarded. During the close time, with its restricted take of seals, this waste of useful material has not been serious, but with the resumption of commercial sealing it will become the duty of the Bureau to endeavor to find a practicable way of utilizing the seal carcasses and of thus making the fur-seal service still more of a revenue producer to the Government. The difficulties connected

with the profitable exploitation of this waste material are the cost of transportation, the absence of harbors, and the uncertainty attending the landing and loading of equipment and products. To this matter, to which considerable attention has already been given, the Bureau will devote still further effort looking to the conduct of the work either by private firms under contract or by governmental agency.

A valuable legacy of the old times, when 5,000,000 pounds of seal carcasses were frequently allowed to rot on the killing grounds in a single year, is the accumulation of bones. No use was ever made of this important fertilizer, and it has remained for the past year to record the first attempt to secure the commercial utilization of seal bones.

The Bureau has conducted considerable preliminary work to determine the extent and value of the seal-bone accumulations, and has interested numerous individuals and firms in the matter. In the summer of 1916 a considerable quantity of bones was collected and sent down on the supply ship; and samples of this shipment in lots of 50 to 300 pounds were, on request, sent to various persons for examination. An analysis made by the Bureau of Soils, Department of Agriculture, showed that these bones, some of the samples of which were from seals killed many years ago, have valuable fertilizing properties, containing from 24.85 to 25.26 per cent of phosphoric acid and from 4.57 to 4.80 per cent of nitrogen. A report received from the islands indicated that the bone deposits actually in sight represent about 6,000 tons, with a number of killing grounds not included; and it has become apparent that, notwithstanding the skepticism and scoffing of certain persons who had formerly been on the islands, there exists in these bones a valuable resource which should be put on the market, especially at this time when the supply of fertilizers has been reduced by the war.

Some of the bones, resulting from the most recent killings, are on the surface, but most of them have become overgrown with grass and are covered with earth and sand. During the past year the natives have been employed, at such time as their other labors would permit, in collecting bones. Owing to the frozen state of the ground, the work of gathering bones is mostly confined to the period from May to November. This coincides with the active sealing season when every able-bodied native must devote considerable time, and some of them all the time, to sealing operations, the landing of supplies, the shipment of skins, and occasionally to important construction work. For these reasons the quantity of bones that would otherwise have been available in the season of 1917 was curtailed, but nevertheless several hundred tons were gotten ready and will be shipped as opportunity is offered. The poor roads on the islands hinder the transportation of bones from the deposits to the villages, but the situation is being improved, and a light motor-truck equipment is being provided to facilitate this work. Bone crushers have been sent to the islands so that bones may be ground and thus be put in compact form to save space in transportation.

After considerable correspondence and negotiation with various persons and companies in regard to the utilization of the bone deposits on the Pribilof Islands, the Bureau early in July, 1917, accepted an offer made by a Seattle firm to pay \$30 per ton for 300 tons or less

delivered f. o. b. vessel at dock in Seattle. A similar offer may be expected for all the bones that may be obtainable in the next few years.

Arrangements are being made so that all other by-products resulting from the taking of fur-seal skins will be utilized. It is expected that use can be made of all seal gullets, which have been found to be convertible into a good grade of light leather suitable for special purposes. Experiments are now under way to use the intestines for casings. The blubber is being saved for use in dressing the skins. A small canning outfit was sent to the islands in the summer of 1917 with a view to determining the feasibility of canning seal meat, of which a quantity far in excess of the natives' needs will hereafter be available. A considerable quantity of the waste products resulting from sealing operations will be required for feeding the fox herd on St. George Island, where the supply of natural food during the winter is very limited.

Careful consideration is now being given the plan of installing a small plant at the Pribilof Islands for the purpose of preparing oil and fertilizer or other products from the excess refuse material resulting from the seal killings. This matter will be definitely worked out before another season, so that there will be no loss of any part of the seal products. This is a distinct advance over conditions which existed at the Pribilof Islands when commercial killing was in progress years ago, for at that time there was no effort to make use of any part of the seal except its pelt.

In anticipation of large sealing operations and the necessity of employing the best methods in taking, curing, and caring for the skins of fur seals, and also of blue foxes, an arrangement was made with Messrs. Funsten Bros. & Co. whereby there were sent to the islands in the season of 1917 two experienced seal men from Newfoundland and two expert sealskin handlers from St. Louis. These men are to cooperate with the agents, instruct the natives, and bring into closer relation than heretofore the seal fishery and the sealskin trade.

#### BLUE FOXES AND REINDEER ON THE PRIBILOF ISLANDS.

In September, 1916, the skins of blue and white foxes that had been taken on the Pribilof Islands in the preceding winter were sold at public auction in St. Louis. The extraordinary prices received for blue-fox skins in the 1915 sale were not obtained in 1916. The best lots brought \$113, \$125, \$128, and \$135 per skin, the average for the entire collection of 420 being \$48.20. The 20 white-fox skins brought \$14.25 each. The gross receipts from this sale were \$20,527.

During the winter of 1916-17 the foxes on St. George Island were found to be unusually numerous, and there was a noteworthy increase in the number of pelts obtained. The take of 417 blue-fox skins and 2 white-fox skins left an ample reserve, 413 foxes having been marked and released, while many unmarked animals were known to be on the island at the end of the trapping season. The pelts obtained on St. Paul Island numbered 150 blues and 37 whites. These skins, numbering 606, were sent to Seattle on the steamer *Roosevelt* in August, 1917.

In compliance with a request from the Bureau of Biological Survey, Department of Agriculture, there were furnished from the Pribilof Islands six pairs of blue foxes for an experimental fox farm located in New York. The foxes were captured on St. George Island, taken to Seattle on the supply steamer, and delivered to an agent of the Department of Agriculture; two of the animals died en route.

From the small number of reindeer placed on the seal islands in 1911, there has grown a herd which in August, 1916, numbered about 196 animals of all ages. A few of the males have been appropriated for the food purposes of the natives, and plans have been made for increasing the usefulness of the reindeer to the natives.

#### VESSEL FOR THE PRIBILOF ISLANDS.

St. Paul and St. George Islands, which are the two important islands of the Pribilof group, are approximately 40 miles apart. At present there is no safe means of getting from one island to the other except upon the infrequent occasions when a Coast Guard cutter happens to be in the vicinity or the Bureau's supply steamer *Roosevelt* is making a regular trip. These islands are practically in the center of Bering Sea and are exposed to heavy storms, hence the small launches now in use are altogether unsuited and unsafe for this journey between the islands. It is therefore felt that a stanch vessel at least 75 feet in length and about 18 feet in breadth, and powered with an internal-combustion engine of at least 125 horsepower, should be secured for use at the islands. This vessel should be of the type which has been developed as the most satisfactory form of cannery tender for use in the exposed waters of Alaska, capable of riding out a gale when necessary.

A tender of this character for the islands is very much needed for the transportation of persons, especially at the time when the important work of the fur-seal census is in progress, and it is also needed for the transportation of supplies from one island to the other. It is required for occasional trips to Unalaska, the nearest town, 250 miles distant. With the resumption of commercial sealing operations next season, such a vessel will be very valuable in handling the increased take of fur-seal skins and other products, particularly in the matter of lightering cargo to the ship, which must anchor some distance offshore. A tender of this type may also be very important for use at times as an auxiliary in guarding the fur-seal herds.

It is therefore recommended that Congress be asked to authorize the construction or purchase of a vessel of this character for the purposes stated, and an item to this end has been inserted in the estimates of appropriations for 1919.

#### SEALSKINS TAKEN BY ABORIGINES.

Under certain restrictions Indians, Aleuts, and other aborigines dwelling on the Pacific coast of North America north of the thirtieth parallel of north latitude may hunt fur seals. Primitive methods of capturing seals are enjoined by law and treaty and the

annual take of skins by the aborigines residing in the United States is quite small. From communications which the Bureau receives from time to time, it is evident that some fur-seal skins are being taken by Indians in British Columbia. No information is at hand to indicate that any considerable number of seals were taken by Alaskan natives in the calendar year 1917. A few skins are known to have been taken in the vicinity of Sitka, Alaska, by Indians in the spring of 1917, the seals having been speared, and it is reported that the natives still have these skins and understand that they must be authenticated if they are to become items of trade. In May and June, 1917, certain Indians of the State of Washington engaged in fur-seal hunting. The Bureau again secured, through the Department of the Interior, the cooperation of Dr. C. L. Woods, superintendent and physician in the United States Indian Service at Neah Bay, Wash., in the matter of authenticating the skins. To date (Aug. 17) the Bureau has received from Dr. Woods certificates in regard to 513 of these skins. These certificates indicate that all were speared from canoes and that 211 were taken from male seals and 302 from females.

#### **MINOR FUR-BEARING ANIMALS OF ALASKA.**

##### **WORK OF THE WARDENS.**

The force of wardens was active in the season of 1916-17, and was located as advantageously as possible with reference to the trapping operations. The shortage of funds for this service, occasioned by the greatly increased cost of supplies for the Pribilof Islands, restricted the movements of the wardens and impaired the efficiency of the service.

There have been several complaints and prosecutions for violations of the fur-bearing-animal laws and regulations of Alaska. Notwithstanding that strong evidence was submitted in the cases taken to court, no convictions resulted. The general sentiment, particularly in the sparsely populated and remote districts, is such that convictions for violations of the fur-bearing-animal laws and regulations are secured only with the greatest difficulty. In addition, a number of investigations have been made of complaints of alleged poisoning and illegal trapping.

##### **REGULATIONS.**

No new regulations governing the taking of fur-bearing animals were issued during the season 1916-17.

In connection with the total prohibition of the killing of martens for a period of five years from March 15, 1916, it has developed that certain trappers wished to retain possession of skins legally taken; and in order that no injustice might be done the owners of such skins, when they desired to ship them, arrangements were made for recording all these pelts that it was proposed to hold in Alaska after November 15, 1916. All shipments of marten skins from Alaska after that date will be checked against the records thus obtained. The Bureau has received 58 such reports, covering 3,031 pelts.

For some years the Post Office Department has aided the Department of Commerce in obtaining statistics of the furs shipped from Alaska by mail. An order of the Postmaster General dated May 4, 1917, published in the Postal Guide for June, reaffirmed the policy of cooperation and made certain changes in instructions to postmasters which will undoubtedly result in an improved service. The new order became effective October 1, 1917.

#### FURS SHIPPED FROM ALASKA.

Statistics compiled by the Bureau indicate that during the period from November 16, 1915, to November 15, 1916, the value of the furs shipped from Alaska was \$911,244, exclusive of the fur-seal and fox skins from the Pribilof Islands, as against \$400,532 in the preceding similar period. The leading fur bearers of the Territory are foxes, lynxes, minks, muskrats, and land otters. In 1916 there was a noteworthy increase in the number and value of most of the important pelts shipped to market. The number of lynx pelts was 21,608 against 9,374 in 1915, and the average price advanced from \$8 to \$12. The number of red-fox skins increased from 11,770 to 15,711, and the average price increased from \$8 to \$12. Over 101,000 muskrat skins came out in 1916 against less than 33,000 in the previous year. The shipment of mink skins fell off slightly but the average value advanced 100 per cent.

#### FUR FARMING IN ALASKA.

Although Alaska is well known as a producer of furs, it is not believed that its possibilities for fur farming, particularly the breeding of foxes, have been generally appreciated or recognized. There are various sections where it has been demonstrated that such operations may be conducted successfully. For several years past there have been a number of fur farms in operation on the Tanana and Yukon Rivers. The Copper River district is another section where fur farming has been prosecuted with a considerable measure of success. Still another region which has proved suitable is the Chilkat Valley in southeastern Alaska. Fur farming has also been conducted for many years on islands, particularly in the Afognak-Kodiak region, and islands to the westward, including the Shumagin Group.

In southeastern Alaska a number of islands have been devoted to fur farming, but except in one or two instances operations have not been successful. As in the case of other islands elsewhere in Alaska, this appears to have been due to the impression that it was only necessary to release a few pairs of foxes upon an island and in due time reap an easy harvest of pelts. In some cases even this indifferent method was moderately successful, but real success in the propagation of foxes on islands in Alaska has occurred only where intelligent supervision has been given. There has been a notable improvement along this line in recent years. It is now the custom on some of the islands and in all cases of fur farms on the mainland to construct carefully designed wire inclosures, or corrals, where the animals are subject to that attention which experience has demonstrated to be essential to success. There appears to be no reason why Alaska

should not assume a much more important rôle than heretofore in the business of fur farming.

At the end of the fiscal year 1917 four islands were under lease by the Department for the propagation of fur-bearing animals. These were Middleton, Simeonof, Little Koniuji, and Marmot Islands. The lease of Carlson Island was canceled November 22, 1916, and Marmot Island was leased for five years, beginning September 1, 1916, at \$200 per year. Negotiations have been pending for the lease of Pearl Island.

#### MISCELLANEOUS MATTERS.

##### SPECIAL CONSTRUCTIONS AND IMPROVEMENTS.

No new hatcheries or laboratories were authorized during the fiscal year but a number of special appropriations became available for improvements at several stations, and construction work was also in progress at various stations under former appropriations.

At Key West, Fla., the site of the marine biological laboratory authorized some years ago, a salt-water reservoir, 40 by 45 feet, has been excavated together with a canal 210 feet long connecting the reservoir with the open bay. The canal is to be provided with gates, and an ample supply of pure sea water is assured. Part of the foundation for the laboratory has been constructed, and plans and specifications for a residence building and pump house with provisional laboratory have been prepared and bids for their construction have been solicited. An additional appropriation of \$25,000 has been made, but it is evident that, under existing conditions, the amount provided is inadequate for the completion of an acceptable laboratory.

At the Louisville (Ky.) station, the construction work has included six concrete rearing ponds 8 by 20 feet, an earth pond 79 feet square for growing aquatic plants and minute animal food for young fish, and supply and drainage pipes. With the exception of a fence, this station is regarded as complete.

At the Springville (Utah) station, a hatchery and a superintendent's dwelling have been built. The hatchery, 34 by 97 feet, contains 120 troughs, with ample office, storage, and other rooms. The dwelling is a frame structure with 8 rooms and modern conveniences.

The old wooden flume for supplying water to the Duluth (Minn.) hatchery has been replaced by an iron pipe line.

Bids within the limits of the several appropriations for a retaining basin for brood fish at the Gloucester (Mass.) hatchery, for a lobster-rearing plant for New England, and for two new steel fish-distribution cars have not as yet been obtained.

The title to the property on Block Island, R. I., selected for a fish-cultural station as authorized by the act of Congress approved June 23, 1913, was found, on investigation, to be somewhat involved, and it was necessary, in accordance with the State law, to obtain from the probate court of the town of New Shoreham permission to sell the property. This was granted by decree of the court on October 2, 1916. The Legislature of the State of Rhode Island, in 1909, ceded to the town of New Shoreham all control over the waters within 1 mile of the shore of Block Island and granted the electors of that town authority to enact ordinances to protect and regulate

the taking of fish in Great Salt Pond. The act of the State legislature granting certain privileges to the United States Commissioner of Fisheries, approved by the governor of Rhode Island on May 11, 1914, therefore does not apply to the waters adjacent to the property selected on Block Island. In order to cover this privilege, the town council of the town of New Shoreham on June 20, 1917, passed the following resolution:

*Resolved*, That the United States Commissioner of Fisheries and his agents be and they are hereby granted unrestricted right to fish in the waters adjacent to Block Island and the right to conduct fish-cultural operations in any manner, at any time that may by them be considered necessary and proper, together with the right to fence in the small cove [adjoining the property selected] and the exclusive right to the use of this cove.

The Government, however, has not been able to accept the deed to the property as the State of Rhode Island has no law which cedes jurisdiction to the United States over the land which the Government may acquire for fish-cultural purposes. The governor of the State has been requested to assist in procuring the passage of such an act by the legislature during the next session, which meets in January, 1918.

At the Clackamas (Oreg.) station a new salmon hatchery was constructed with an appropriation that was made available in 1914. The structure is 58 by 100 feet. Its lighting is rendered almost perfect from white inside finish and 43 prism-glass windows. Other new buildings provided at this place were a combination carpenter shop and woodshed, 20 by 40 feet, a garage and lumber storage combination 22 by 30 feet, a pump house 12 by 18 feet, and a paint house 9 by 15 feet. All new buildings are on concrete foundations and so constructed that decaying floors can not affect the walls or other parts. The station is practically new and highly attractive in appearance. A new water system was installed with two electrically driven pumps, which are separate units. Their combined delivery is 1,600 gallons per minute, the discharge being into an excavated reservoir of 210,000 gallons capacity.

Taking advantage of the lull in fish-cultural operations at the Michigan stations during the first three months of the fiscal year, important repairs and improvements were made to the water supply and pond system at Northville, a special appropriation for the purpose having been obtained. The work included the grading and enlargement of the spawning space in two of the bass ponds, replacing 487 linear feet of old vitrified sewer crock connecting the dam and the water-supply reservoir with 16-inch iron pipe, and repairs to the retaining wall protecting the water-supply system.

#### CONSTRUCTION, REPAIR, AND MOVEMENTS OF VESSELS.

The act providing appropriations for the support of the Bureau for 1917 contained an item of \$10,000 for two motor boats for the Alaska fishery patrol. Bids for the construction of these boats were opened at Seattle on December 5, 1916, seven proposals being received. The contract was awarded to a local firm, the work began at once, and the boats were completed and accepted on May 10, 1917. The contract price was \$9,352, and the entire cost, including plans and inspection, was \$9,702.70. The boats resemble the type of boats used in the purse-



seine fishery for salmon, carry a crew of three men, and have accommodations for two fishery agents. They are 48 feet long and 12½ feet beam, draw 5½ feet of water, are lighted by electricity, are driven by 25 horsepower distillate engines, and have a normal speed of 8½ knots per hour. The fuel tanks have a capacity of 600 gallons, giving a radius of action of about 3,000 miles. The new boats, which have been named the *Auklet* and the *Murre*, after two common water birds of the Alaskan coast, left Seattle on July 7 for Alaska, reported at Wrangell on July 12, and immediately entered on fishery patrol work in southeast Alaska.

The steamer *Halcyon*, provided for the Boothbay Harbor station and described in last year's report, was launched November 30, 1916, and finally completed and accepted by the Bureau May 3, 1917. The vessel was immediately transferred to the Navy.

The steamer *Albatross* during the early part of the fiscal year continued the tuna investigation along the California coast until November 23, when she proceeded to San Francisco, arriving November 26. Soon afterward she was docked to ascertain what repairs and overhauling were necessary. A deficiency appropriation of \$10,000 becoming available on May 2, the vessel was taken to Mare Island Navy Yard where the work was undertaken. During the year the vessel cruised 4,833 miles, using 717.9 tons of coal at a cost of \$7,273.44.

The steamer *Fish Hawk* was engaged in fishery investigations in Chesapeake Bay, making trips at intervals from July 1, 1916, to March 22, 1917, since which time she has been chiefly on naval duty. Before the vessel can be used for any outside work, considerable repairs to the hull are necessary, and new engines should be provided. During the year the vessel, while employed in the service of the Bureau, cruised 681 miles, using 581 tons of coal at a cost of \$1,659.47.

The steamer *Roosevelt* sailed on January 23, 1917, from Norfolk en route to Seattle, where she arrived April 23, having been detained at Guantnamo over a month on account of the international situation and at Balboa nearly three weeks for repairs. At the end of the year she was ready to transport supplies to the Pribilof Islands.

The auxiliary schooner *Grampus* was engaged from July 18, 1916, to April 24, 1917, in oceanographic and other investigations on the Atlantic coast and fishery investigations in the Gulf of Mexico. In April the vessel reached Washington, and sailed thence on May 15 for Gloucester, Mass. Defects have developed in the hull of the *Grampus* incident to age and very active and continuous service, and the question is being considered as to whether the expense of rebuilding is warranted. The vessel is of an obsolete type and not at all suited to the present needs of the Bureau.

The steamer *Phalarope* has been utilized, as usual, in connection with the hatchery and laboratory at Woods Hole, Mass., and in shad hatching on the Potomac River; and the steamer *Gannet* has been actively employed at the Boothbay Harbor (Me.) station.

#### PUBLICATIONS.

The publications of the Bureau issued and distributed during the fiscal year are here noted. These were supplied chiefly through the Superintendent of Documents to persons on special mailing lists.

The Fisheries Service Bulletin, issued monthly, has proved very popular and useful. It is of special interest to employees, who are

thus kept informed of the current work of the service of which they are a component part. Every employee receives a copy of each issue and maintains a file. In the course of the year it was necessary at times to increase the number of pages to accommodate all the matter desirable for publication, and the monthly edition has also been enlarged.

Effective February 1, 1917, the Bureau discontinued the free distribution of its general publications. This action was necessitated by the increasing demands and the limited allotment available for printing. Hereafter applications for publications will be referred to the Superintendent of Documents, who will supply them at prices representing the actual cost of paper and press work. The only exceptions will be institutions and specialists collaborating or exchanging with the Bureau and State and foreign fishery officials. Documents issued in the Bureau's exploitation and propaganda work, together with the Commissioner's annual report, statistical bulletins, and the Fisheries Service Bulletin, will be supplied as heretofore.

## REPORT OF THE COMMISSIONER AND APPENDIXES THERETO.

Report of the Commissioner of Fisheries to the Secretary of Commerce for the fiscal year ended June 30, 1916: 114 p.

Alaska fisheries and fur industries in 1915. By Ward T. Bower and Henry D. Allen. Appendix III to Report of Commissioner for 1915. 140 p.

Pacific cod fisheries. By John N. Cobb. Appendix IV to Report of Commissioner for 1915. 111 p., 9 pl., 1 map.

Survey of the fishing grounds on the coasts of Washington and Oregon in 1915. By Edward C. Johnston. Appendix VI to Report of Commissioner for 1915. 20 p., 4 charts.

Explorations of the United States Coast and Geodetic Survey steamer "Bache" in the western Atlantic, January-March, 1914, under the direction of the United States Bureau of Fisheries. By Henry F. Bigelow. Appendix V to Report of Commissioner for 1915. 62 p., 1 chart, 53 text fig.

Distribution of fish and fish eggs during the fiscal year 1916. By Henry O'Malley. Appendix I to Report of Commissioner for 1916. 112 p.

Pacific salmon fisheries (revised edition). By John N. Cobb. Appendix III to Report of Commissioner for 1916. 255 p., 29 pl.

Fish laws of Mississippi River States: A digest of statutes relating to the protection of fish and miscellaneous aquatic animals of States bordering on the Mississippi River. By Emerson Stringham. Appendix IV to Report of Commissioner for 1916. 20 p.

Condition and extent of the natural oyster beds and barren bottoms in the vicinity of Apalachicola, Fla. By Ernest Danglede. Appendix V to Report of Commissioner for 1916. 68 p., 1 map, 7 pl.

Fishing in the Priamur district of Siberia. By John K. Caldwell. Appendix VI to Report of Commissioner for 1916. 31 p.

Mortality of fishes on the west coast of Florida. By H. F. Taylor. Appendix III to Report of Commissioner for 1917. 24 p., 4 p. of pl.

## BULLETIN OF THE BUREAU OF FISHERIES.

The structure and growth of the scales of the squeteague and pigfish as indicative of life history. By H. F. Taylor. Bulletin xxxiv, 1914, p. 285-330, 8 text fig., pl. I-LIX.

Notes on the fishes of east Tennessee. By Barton W. Evermann and Samuel F. Hildebrand. Bulletin xxxiv, 1914, p. 431-451, 13 text fig.

The histological basis of adaptive shades and colors in the flounder *Paralichthys obliquatus*. By Albert Kuntz. Bulletin xxxv, 1915-16, p. 1-30, 8 text fig., pl. I-IX.

## SPECIAL PUBLICATIONS.

Investigations, experiments, and surveys relative to the aquatic resources of the United States conducted by the Bureau of Fisheries during the fiscal year ended June 30, 1916. Extracted from Report of the Commissioner of Fisheries to the Secretary of Commerce for the fiscal year ended June 30, 1916, p. 34-49.

Commercial fisheries of the United States and the operations of the Bureau of Fisheries in connection therewith during the fiscal year ended June 30, 1916. Extracted from the Report of the Commissioner of Fisheries to the Secretary of Commerce for the fiscal year ended June 30, 1916, p. 50-100.

The work of the Bureau of Fisheries and its fish-cultural station at Boothbay Harbor, Me. 13 p., 6 text fig.

#### ECONOMIC CIRCULARS.

- No. 22. The grayfish. Try it. It knocks H out of the H. C. of L. 8 p., 1 text fig.  
 No. 23. The sablefish, alias black cod. An introduction to one of the best and richest American food fishes, with recipes for cooking it. 6 p., 1 text fig.  
 No. 24. Artificial propagation of the diamond-back terrapin. 21 p., 5 text fig. (Revised edition.)  
 No. 25. The question of fishways. 6 p.  
 No. 26. The burbot: A fresh-water cousin to the cod. 4 p., 1 text fig.  
 No. 27. The bowfin: An old-fashioned fish with a new-found use. 4 p., 1 text fig.  
 No. 28. A practical small smokehouse for fish. How to construct and operate it. 7 p., 3 text fig.  
 No. 29. Preserving fish for domestic use. 2 p.

#### STATISTICAL BULLETINS.

Monthly and annual statements of the quantities and values of certain fishery products landed by American fishing vessels at the ports of Gloucester and Boston, Mass., Portland, Me., and Seattle, Wash.

#### SOME NEEDS OF THE FISHERIES SERVICE.

The Commissioner renews his previous recommendations for a modern building with ample laboratory facilities for the Washington headquarters combined with an aquarium for experimental and observational work in fish breeding, fish feeding, and fish pathology. The aquarium should be adapted for public education and should be recognized as a national institution. The need for and benefits to be derived from such a building are fully set forth in the Secretary's communication to the Speaker of the House of Representatives on April 2, 1917, printed as House Document No. 117, Sixty-fifth Congress, first session.

In order more adequately to perform the duties devolving on the Bureau, more particularly those that have received an added importance because of the national crisis that necessitates increased output of food and industrial materials, there is urgent need for additional personnel and facilities for practical and immediately productive work in furtherance of the activities heretofore referred to, in behalf of the exploitation of neglected aquatic resources, the methods of preservation best adapted to the various products and communities, and the prevention of waste in all branches of the fisheries. Items have been included in the estimates of appropriations for the next fiscal year that will meet some of the Bureau's needs in respect to these matters.

Respectfully submitted.

H. M. SMITH,  
*Commissioner of Fisheries.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*

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**REPORT**  
**OF THE**  
**COMMISSIONER OF LIGHTHOUSES**

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# REPORT

## OF THE

### COMMISSIONER OF LIGHTHOUSES.

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DEPARTMENT OF COMMERCE,  
BUREAU OF LIGHTHOUSES,  
*Washington, September 15, 1917.*

SIR: The following report is submitted of the operations of the Lighthouse Service for the fiscal year ended June 30, 1917:

#### ORGANIZATION OF THE LIGHTHOUSE SERVICE.

The general organization of the Service remained unchanged during the fiscal year.

#### AIDS TO NAVIGATION.

During the fiscal year ended June 30, 1917, there was a net increase of 275 in the total number of aids to navigation maintained by the Lighthouse Service. There was an increase of 5 fog signals, 33 lighted buoys, 189 unlighted buoys, and 62 minor lights (including 12 float lights).

Fixed lights were changed to flashing or occulting at 39 stations. The illuminant of 17 lights (including 1 light vessel) was changed to incandescent oil vapor, the illuminant of 26 lights (including 4 light vessels) was changed to acetylene, the illuminant of 13 lights was changed to electric incandescent, and the illuminant of 1 light was changed to oil gas.

On June 30, 1917, there were maintained by the Lighthouse Service 15,223 aids to navigation, including 5,420 lights of all classes and 588 fog signals (not including 81 whistle and 241 bell buoys), of which 51 are submarine signals. It is believed that the systematic methods of improvement and the use of modern apparatus in increasing the number and brilliancy of aids have been of value to the safety of commerce.

The table following gives a summary of the aids to navigation, under each class, established and discontinued during the fiscal year, and also the net increase, and the number in commission at the end of the fiscal years 1916 and 1917.

Class.	1917			Total, June 30—	
	Estab- lished.	Discon- tinued.	In- crease.	1916 <sup>a</sup>	1917.
<b>Lighted aids:</b>					
Lights (other than minor lights).....	39	39	.....	1,708	1,708
Minor lights.....	185	135	50	2,920	2,970
Light-vessel stations.....	.....	.....	.....	53	53
Gas buoys.....	73	40	33	512	545
Float lights.....	23	11	12	132	144
<b>Total.....</b>	<b>320</b>	<b>225</b>	<b>95</b>	<b>5,325</b>	<b>5,420</b>
<b>Unlighted aids:</b>					
Fog signals.....	8	3	5	532	537
Submarine signals.....	.....	1	1	52	51
Whistling buoys, unlighted.....	4	6	2	83	81
Bell buoys, unlighted.....	8	5	3	238	241
Other buoys.....	375	186	189	6,657	6,846
Day beacons.....	96	110	14	2,061	2,047
<b>Total.....</b>	<b>491</b>	<b>311</b>	<b>180</b>	<b>9,623</b>	<b>9,803</b>
<b>Grand total.....</b>	<b>811</b>	<b>536</b>	<b>275</b>	<b>14,948</b>	<b>15,223</b>

<sup>a</sup> Differences from statistics published in 1916 report are due to minor discrepancies in previous count.

<sup>b</sup> Decrease.

The following are some of the more important aids which have been established or materially improved during the past fiscal year:

A new third-order light station with a flashing white oil-vapor light and a first-class air siren was placed in commission at Cape St. Elias, Kayak Island, Alaska.

A new light vessel, *No. 101*, was established off Cape Charles, Va., in place of the old vessel, *No. 49*, and a new light vessel, *No. 102*, took the place of old *No. 43* at Southwest pass entrance to the Mississippi River, La.

The illuminating apparatus on Brunswick Light Vessel No. 84, Ga., was improved by changing from two fixed white to one flashing white light, and a similar change was made on Handkerchief Light Vessel No. 3, Nantucket Sound, Mass.

Fog signals were established at Eagle River Shoals, Lake Superior, Mich. (electric siren); Manistique, Mich. (air diaphone); Sheboygan Breakwater, Lake Michigan, Wis. (first-class air siren); and Cleveland West Pierhead, Ohio (air diaphone). Four air diaphones were installed on the Pacific coast in place of sirens or whistles at the following stations: Scotch Cap, Unimak Pass, Alaska; Cape Flattery, Tatoosh Island, Wash., Farallon and Point Conception, Cal.

Important lighted buoys were established at The Graves, Boston Harbor, Mass. (whistle); Popasquash Point, Narragansett Bay, R. I. (bell); Conaskonk Point Shoal, Raritan Bay, N. J.; Bulkhead Shoal Channel, Delaware River, Del. (3 buoys); Sewall Point Shoal, Hampton Roads, Va. (bell); Caucus Cut Entrance, Pensacola Bay, Fla. (whistle); Mobile Bay Entrance, Ala. (4 buoys, 1 with whistle); Brazos River Entrance, Tex. (2 buoys, 1 with bell); Manchas Grandes, Mayaguez Harbor, P. R.; Gravelly Island Shoal, Lake Michigan, Mich. (bell); Outer Shoal, Lake Michigan, Wis. (bell); Orca Inlet (2 buoys) and Reef Island Reef, Prince William Sound, Alaska; Poundstone Rock, Favorite Channel (bell), and Channel Rock, Sitka Sound, Alaska; Duwamish Head, Seattle Harbor, Wash. (bell); and Grays Harbor Outside Bar, Wash. (whistle).

Systems of minor aids and buoyage were extensively rearranged or improved in the following important localities: Sand Shoal and Smith Island Inlets and Magothy Bay, Va.; Caximbas Pass, Fla.; Mobile Bay, Ala.; Houston Channel, Tex.; Tonowek Bay, Karheen Passage, and Zimovia Strait, Alaska; and San Diego Bay, Cal.

Flashing acetylene lights were established at Hunts Point, East River, N. Y.; Delaware City, Del.; Rancocas River Range, N. J. (2 lights); Fishing Point, Assateague Anchorage, Va.; Lower Cedar Point Beacon, Port Tobacco River Flats, and Persimmon Point Shoal, Potomac River, Md.; Tunnel Island Spit, Va.; Bull Spit, Fenwick Island Cut, Marsh Island Spit, and Steamboat Creek, S. C.; Two Harbors West Breakwater, Lake Superior, Minn.; Tonawanda Channel Range, Niagara River, N. Y. (2 lights); Fighting Island, Detroit River, and Portage Lake Pierhead, Mich.; San Diego Bay, Cal.; Cape Edwards Entrance, Hanin Rocks, Kodiak Harbor, Alaska; Kukii Point, Kauai Island, and Kipahulu, Maui, Hawaii.

The beginning of lighthouse work in America was commemorated in Boston, Mass., on September 25, 1916, when a bronze tablet was unveiled at Boston Light Station, on the two-hundredth anniversary of its establishment. The Secretary of Commerce was present on the occasion and a number of Federal, State, and municipal officers, as well as representatives of commercial, maritime, and historical organizations of Boston. A full account of this celebration was published as a special bulletin of the Lighthouse Service.

The Gulf coast again suffered from three tropical hurricanes during the fiscal year, the same as last year. These storms occurred on July 5, 1916, in the general vicinity of Mobile, Ala.; on August 18, 1916, near Aransas Pass, Tex.; and on October 18, 1916, around Pensacola Bay, Fla. The July storm was by far the most severe and damaged property of the Lighthouse Service to the extent of about \$140,000. Congress, by the act of September 8, 1916, appropriated \$125,000 to repair this damage. The aggregate damage of the August and October storms was about \$60,000. No lives of persons in the Lighthouse Service were lost in any of these storms.

Ice conditions during February, 1917, were unusually severe in the North Atlantic coast districts, and many aids to navigation, as well as lighthouse vessels, were damaged, particularly in Buzzards Bay, Mass.; New York Bay, N. Y. and N. J.; Delaware Bay, N. J. and Del.; and Chesapeake Bay and tributary waters, Maryland and Virginia.

For the general assistance of persons navigating in motor boats and other small craft, the Department issued a card with illustrations showing various types of buoys and brief rules regarding their colors and numbers, along with the distances of visibility for objects of stated elevations above sea level.

In furtherance of the project for the improvement of coastal communication facilities, and as a result of the inquiry referred to in last year's annual report, the United States Coast Guard is preparing to install telephone service at about 75 light stations on the Atlantic, Gulf, and Pacific coasts.

#### ALASKA.

The total number of aids to navigation in Alaska, including lights, gas buoys, fog signals, buoys, and daymarks, in commission at the



close of the fiscal year ended June 30, 1917, was 416, including 152 lights and 7 gas buoys, representing an increase of 122 lighted aids since June 30, 1910, or 330 per cent. The following table, which gives the total number of aids to navigation on June 30 of each year named, illustrates the progress in establishing aids in the Territory:

Aids.	1910	1911	1912	1913	1914	1915	1916	1917
Lights.....	37	71	85	93	108	112	147	152
Gas buoys.....								7
Fog signals.....	9	10	10	10	10	10	11	11
Submarine bell.....								1
Buoys.....	84	105	132	136	157	167	181	189
Daymarks.....	30	29	38	40	44	49	49	56
Total.....	160	215	265	279	319	338	388	416

The light and fog-signal station at Cape St. Elias, for which an appropriation of \$115,000 was made by the act of October 22, 1913, was completed during the year and lighted for the first time on September 6, 1916. Within a few weeks after its establishment a master of a passing merchant vessel reported that reflections of the light were visible at a distance of 37 nautical miles on a cloudy night with heavy rain squalls and a rough sea.

The appropriation of \$60,000 made by the act of August 1, 1914, for aids to navigation in Alaska has been practically expended after providing needed improvements at about 40 places. A further appropriation of \$60,000 was made for the same purpose by the act of June 12, 1917. Work on this project was started at once, and good progress has been made up to the date of this report.

The new lighthouse tender *Cedar*, for which \$250,000 was appropriated by the act of January 25, 1915, was practically completed during the fiscal year, except for a few minor items, and sailed from Long Beach, Cal., on July 11, 1917, for assignment to Alaskan duty. The tenders *Kukui* and *Fern* have been assigned to the Alaska district during the year.

#### GUANTANAMO, SAMOA, AND GUAM.

The aids to navigation in the outlying United States territory at Guantanamo Bay, Cuba, the American Samoan Islands, and the island of Guam are maintained under the supervision of the naval commandants by means of allotments made from the appropriations for the Lighthouse Service. Reports have been received from naval officers in local charge indicating that the aids have been properly maintained, at an approximate annual expense as follows: Guantanamo, \$4,190; Samoa, \$920; Guam, \$700.

In addition to the duty of maintaining the aids to navigation, the commandant of the naval station at Guantanamo Bay continued to render valuable assistance to the Lighthouse Service by his cordial cooperation in connection with lighthouse-construction work at Navassa Island, West Indies, which is remote from any other United States possession.

#### VIRGIN ISLANDS.

The lighthouse work in the islands of St. Thomas, St. Croix, and St. John, with the outlying rocks and islets, formerly constituting the Danish West Indies and now the Virgin Islands of the United

States, was by Executive order dated July 20, 1917, placed under the Lighthouse Service, following the customary procedure in such cases. In the portion of this report devoted to financial matters the detail of an estimate of \$50,000 to carry out this work is submitted.

#### ENGINEERING AND CONSTRUCTION.

New works of principal importance under special appropriations completed during the fiscal year are as follows: New carpenter shop at the general depot, Tompkinsville, N. Y.; Charleston depot, Charleston, S. C.; Manistique lights and fog signal, Michigan; and Cape Saint Elias light and fog signal, Alaska.

Other important work in progress at the close of the fiscal year includes: Dog Island Light, Me.; Woods Hole depot improvements, Massachusetts; aids to navigation, Hudson River, N. Y.; aids to navigation, Delaware River, Pa. and Del.; aids to navigation, St. Johns River, Fla.; additional lights, Florida Reefs, Fla.; lighting Mississippi River below New Orleans, La.; repair of hurricane damage, Gulf of Mexico; Navassa Island light station, West Indies; and aids to navigation at Ashtabula, Cleveland, and Lorain, Ohio.

The most important item of construction work completed during the year was the new Cape St. Elias light station, Alaska, to which reference has previously been made. This light is of 300,000 candlepower and forms the landfall for vessels bound to Prince William Sound or Cook Inlet from either the Pacific coast of the United States or southeastern Alaska.

A large amount of construction work was also performed in the Gulf of Mexico districts, repairing hurricane damage. Care was taken to give the new structures increased strength and rigidity, within the limits of available funds, to avoid such destructive effects in future as far as possible.

A standard form of map and instructions for surveys of lighthouse reservations was prepared and issued during the year, to insure future uniformity in such work.

The standard plans and specifications for helical-bar lanterns were revised during the year, with the principal object of affording increased ventilation where oil-vapor lamps are employed.

A general inquiry as to the efficiency of all unprotected reinforced-concrete structures of the Service located upon submarine sites was instituted during the year, with the object of studying possible deterioration of such structures in sea water and the best means of overcoming any difficulties encountered.

#### IMPROVEMENT OF APPARATUS AND EQUIPMENT.

Floating beacons, designed for emergency use in replacing minor lights in inside waters carried away by ice or damaged by collision, pending the reconstruction of the permanent light, have been built and tested in service with satisfactory results.

A bell float for use in very shoal water has also been designed and tried out. It is reported to give efficient service, the bell ringing almost continuously, even in calm weather.

Experiments have been conducted at the general depot with a view to the manufacture of 375-millimeter (about 15 inches) pressed-glass buoy lenses for use in place of the present expensive cut-glass lenses.

Practical tests, by actual visual observation and by the photometer, indicate that almost equal efficiency can be obtained by the use of pressed-glass lenses, at a cost of about 40 per cent of the former cut-glass lenses, and as a result pressed-glass lenses have been adopted for future use in all 375-millimeter lanterns.

The extension of incandescent oil-vapor lamps to fifth-order lenses has been made with success. It was previously the impression that on account of the small size of the fifth-order lens damage to the prisms might occur from the intense heat of the oil-vapor lamp, but it was found by the use of a metal deflector in the upper portion of the lens the prisms were protected from cracking, without material loss in the resulting efficiency of the light. A six-months' service test of such an installation proved satisfactory.

A committee composed of representatives of the Navy Department and Department of Commerce, including the Lighthouse Service, has been appointed to consider and report on the further use of radio apparatus for fog-signal purposes and to coordinate experimental work along the lines now in progress, and various tests are being made.

Occulting blinds for lights have been designed and manufactured at the general depot. These consist of a frame placed in front of the lens carrying vertical shutters that may be rotated by connecting rods. The rods are actuated through links connected with a cam on the operating clock, and the mechanism is so arranged as to give a practically instantaneous opening and closing of the shutters.

Kerosene for fuel, replacing coal, was in use in the galley range aboard several vessels with good results and has been found more satisfactory than coal. The systems installed consisted of a standard-type outfit as used for oil-vapor lamps, with a starting torch and the necessary accessories, including also specially arranged fire brick.

A new type of post lantern with an automatically occulting light, designed in the Bureau, is now being tested and gives promise of furnishing an improvement.

The continued use of oil engines in place of steam for power and for operating fog signals has demonstrated the greater economy and convenience of such apparatus, and the use of these engines is being extended as boilers now in service become unfit for further use.

A thermostat designed to warn keepers by ringing a bell when undue fluctuations occur in operating oil-vapor lamps has been developed and issued to a number of stations, where it has been found that such thermostats are of benefit to the proper maintenance of the lights.

In the case of a new fog-signal installation a double-mouth cast-iron horn was used in place of the usual sheet-copper horn, effecting an improvement, as it directs the sound equally well, is more durable than the copper horn, and greatly reduces the reflection of sound on the station in back of the horn.

A new type of gas and whistling buoy, of practically the same size as the type L now in use but with the addition of a whistle, has been designed at the general depot. It is believed this will give a buoy of suitable size for channel work and other locations where a larger type would be too heavy.

The work of standardization has been extended during the past year as heretofore, and in many cases articles and parts have been completely standardized and are now interchangeable, so that repair parts may be kept on hand for issue at short notice. Work has also been started on small drawings of such parts, on letter-size sheets so arranged as to bind in book form for distribution to the district offices, facilitating identification and reference.

In the river districts service tests have been made with various types of lantern brackets for lighted buoys and also with various modifications of the barrel body of buoys now in use. It was proposed also to give metal buoys a trial, but the scarcity of material and prevailing prices will make these prohibitive, except for special tests, for the present.

### PERSONNEL.

The following table gives the number of employees (all authorized positions, including some vacancies) of the Lighthouse Service at the end of the fiscal year and a comparison of the totals with those for the previous fiscal year:

EMPLOYEES IN THE LIGHTHOUSE SERVICE ON JUNE 30, 1917.

District.	Inspectors, engineers, force, draftsmen, aids, appointed foremen, and mechanics.	Clerks, messengers, janitors, and office laborers.	Depot keepers and assistants, including laborers.	Light keepers and assistants.	Laborers in charge of lights (appropriation "Salaries, keepers of lighthouses").	Laborers in charge of post lights and buoys (appropriation "General expenses").	Custodians of reservations.	Officers and crews on tenders and light vessels.	Field force for construction and repair (registered).	Field force for construction and repair (unregistered).	Total.
Bureau.....	14	25									39
First.....	3	6	1	114	2			70		9	213
Second.....	4	7	3	78	11			216	2	6	326
Third.....	22	30	17	180	32	56	2	279	178	44	840
Fourth.....	5	5	3	54	6	5	6	29	5	4	122
Fifth.....	11	9	34	173	93	20	1	257	6	6	610
Sixth.....	5	7	2	55	9	26		128	3	18	253
Seventh.....	2	3	1	41	1	7		31	4	14	104
Eighth.....	7	9	16	109	29	34		115	9	41	369
Ninth.....	2	5	1	34	5			24	11	6	93
Tenth.....	8	5	2	65	1		1	33	5	13	133
Eleventh.....	8	6	6	158	10		2	110	16	6	324
Twelfth.....	7	6	5	154	13		1	93	6	5	297
Thirteenth.....	1	2				23		17			343
Fourteenth.....	1	2				539					542
Fifteenth.....	1	2				372		20			395
Sixteenth.....	5	5	1	32		18		45	1	8	115
Seventeenth.....	6	6	4	79	15	117		121	5	2	355
Eighteenth.....	6	6	7	111	8	5		91	6	13	253
Nineteenth.....	4	3	1	27	2			25	3	5	70
Total, 1917.....	122	149	103	1,464	242	1,526	13	1,704	273	200	5,798
Total, 1916.....	123	147	69	1,473	241	1,524	12	1,592	270	340	5,791
Increase.....		2	34		1	2	1	112	3		7
Decrease.....	1			9						140	

### ADMINISTRATION METHODS AND ECONOMIES.

A fourth annual conference of lighthouse inspectors, authorized by the Secretary of Commerce, was held during January, 1917. The program followed the previous general lines, and the results are believed beneficial to the Service.

A compilation of data relating to coal used as fuel for the Service was made, indicating the consumption for the fiscal year 1916 to be about 58,000 tons of bituminous and 9,600 tons of anthracite coal.

A compilation of data relating to hours of fog and its relative prevalence at different seasons of the year was made from information on file, based on the regular records at fog-signal stations. Records of fog have been kept in a systematic manner since 1885 and are now sufficiently complete to provide material for study of this matter from both meteorological and engineering standpoints.

Careful attention was given during the fiscal year both by the Department and the Bureau to conditions affecting pay and subsistence, particularly on board vessels. In order to bring about as uniform conditions as the widely different character of the work of the several maritime bureaus and the Service might permit, the Department authorized a marine board, on which the Lighthouse Service is represented, to consider such problems. A more detailed statement in reference to this question appears in another portion of this report.

The Lighthouse Service took part with other bureaus of the Department at the Southern Commercial Congress held in Norfolk, Va., during December, 1916; and a small exhibit illustrating various types of structures and apparatus was shown at the annual meeting of the Chamber of Commerce of the United States held in Washington, D. C., during January, 1917. The Service was also awarded a gold medal at the Panama-California International Exposition held at San Diego, Cal., during 1916.

With a view to saving the frequent expense of obtaining telegraphic authority, the Department authorized a regulation permitting inspectors to assign suitable persons to duty, under civil-service rules, in cases of death, sickness, or other circumstances where immediate filling of a position is necessary for the proper safeguarding of life and property, with the understanding that the circumstances must be promptly reported by mail.

In order to reduce paper work entailed by reports of officers detailed from one vessel to another for short periods of duty, the Department authorized inspectors to make such details for one month or less without the necessity of obtaining prior authority or reporting the case specially.

Following a suggestion of the Secretary of Commerce, measures were taken to urge all persons on lighthouse reservations to cultivate as much land as possible for growing foods.

The Secretary also suggested a canvass be made throughout the Service relative to subscriptions to the First Liberty Loan Bonds authorized during the year, with the result that 1,066 persons in the Service purchased these bonds to the total amount of \$230,750.

The compilation of a corrected list of lighthouse reservations, mentioned in last year's report, has been completed, showing a total of 1,132 reservations of land owned by the Service, amounting in all to about 134,000 acres.

Systematic inspections of the various lighthouse districts by the general inspector, examiner, and other officers of the Bureau were continued as in former years with satisfactory results.

The standard method of cost keeping was continued as usual, and a general summary of results is given under a separate head.

The Department gave attention during the year to various suggestions offered in the way of saving of paper and other office supplies, and, as a result of these, issued supplemental instructions governing such matters, which have resulted in substantial economies. These embraced the use of half-sheet letter heads, lighter grades of paper, single-spacing of typewritten letters, use of spare paper for scratch pads, etc.

The Bureau also introduced a number of economies in printing, with the assistance of the Division of Publications, so that the expense of printing for the Service during the fiscal year was reduced to 85 per cent of the allotment made for the purpose by the Department.

As a result of tests made at the general depot to determine the relative value of turpentine and "petroleum spirits" in varnishes, it was found that while turpentine was slightly superior the difference was not sufficient to warrant the large excess in price at the present time, and, therefore, instructions were issued to carry petroleum spirits in stock for further service trial.

A special form of pay roll to be used in connection with the 5 and 10 per cent increase in compensation authorized by Congress for persons receiving \$1,800 or less was prepared and issued, to facilitate the handling of this matter by district offices.

#### **COST-KEEPING SYSTEM AND RESULTS.**

A standard method of cost keeping has been continued in effect throughout the fiscal year, and reports have been received from all the districts, in which itemized costs of each office, depot, light and fog-signal station, tender, and light vessel are shown separately. The costs of minor lights, daymarks, and lighted and unlighted buoys are shown in groups by various districts, each type of aid to navigation being accounted for separately. In all cases the costs are divided into main headings—maintenance and betterments. The cost of maintenance includes what may be considered fixed charges, such as salaries, rations, fuel, and general expendable supplies. The item of betterments includes repairs, improvements, and new construction, and is further subdivided to show the cost of labor and materials separately for each principal object.

The costs are based on the actual expenditures during the fiscal year, whether of money or supplies. They are checked with the money accounts by taking into consideration the actual cash expenditures and the difference in the value of supplies on hand at the beginning and at the end of the year. The information from this cost-keeping system is useful in preparing estimates, planning work, effecting economies, and comparing the efficiency of different districts, vessels, light stations, apparatus, methods, etc.

A generalized summary of costs for the fiscal year ended June 30, 1917, follows, as derived from this cost-keeping system. Overhead charges, offices, depots, and tender service are stated as separate features in this summary and are not distributed nor included in the costs of aids to navigation. Notwithstanding the most careful and painstaking efforts to economize in every direction, the recent extraordinary advance in the price of labor and materials is clearly shown in the increased costs reported for practically all features.

## SUMMARY OF COSTS, LIGHTHOUSE SERVICE, FISCAL YEAR ENDED JUNE 30, 1917.

[Amounts are stated to nearest even dollar, causing occasional minor discrepancies in totals. Differences from total expenditures reported elsewhere is due to inclusion of Bureau salaries, printing expenses, and adjustment of inventories of articles furnished from stock.]

## TOTAL COSTS OF PRINCIPAL FEATURES.

Feature.	Maintenance expenses.				Betterment expenses.				Grand total.	Per cent.	
	Salaries.	Subst- ence.	General supplies.	Incidental expenses.	Total.	Repairs and improve- ments.		New works.			Total.
						Labor.	Materials and supplies.				
Administration a.....	\$330,660	.....	\$49,897	\$1,338	\$381,905	.....	.....	.....	\$381,905	6	
Distributive charges b.....	864,961	\$206,909	486,296	27,999	1,586,065	\$149,248	\$158,932	\$207,401	\$515,781	36	
Aids to navigation c.....	1,510,605	255,999	479,523	16,913	2,263,043	289,863	372,833	484,593	3,401,452	53	
Total.....	2,706,226	462,808	1,015,716	46,250	4,233,008	430,111	531,835	692,194	5,887,193	100	

## TOTAL COSTS OF DETAILED FEATURES.

Offices.....	\$330,660	.....	\$73,992	\$1,338	\$404,990	.....	.....	.....	\$404,990	7
Depots.....	191,224	.....	82,664	21,972	296,860	\$31,079	\$40,761	\$48,798	\$120,638	8
Tenders:										
Large.....	188,017	\$55,889	129,085	1,947	374,966	14,805	14,805	78,712	168,322	8
Medium.....	454,321	137,761	233,419	3,729	829,230	97,313	97,314	61,703	246,330	18
Small.....	33,360	13,159	18,033	851	64,412	6,051	6,052	18,388	30,491	2
Total.....	675,737	206,809	380,537	6,027	1,269,176	118,169	118,171	158,803	395,143	28
Light vessels:										
Exposed.....	164,488	39,868	44,868	587	249,840	40,014	40,015	.....	80,029	5
Moderately exposed.....	96,654	27,331	19,581	146	143,714	11,971	11,971	80,470	104,412	4
Relief.....	61,065	16,076	22,007	198	99,346	28,719	28,719	.....	47,433	3
Labs.....	46,486	13,062	11,726	186	70,463	13,270	13,271	26,533	53,074	3
Total.....	367,713	96,367	98,183	1,117	563,412	87,974	87,976	109,003	294,953	14

[illegible]

• Includes light vessels, light stations, minor fixed aids, and buoys.

**\* Includes offices, except expenses of publications.**  
**\* Includes depots and tenders; also item excepted above, charged to supplies.**



## SUMMARY OF COSTS, LIGHTHOUSE SERVICE, FISCAL YEAR ENDED JUNE 30, 1917—Con.

## AVERAGE COSTS OF SELECTED FEATURES.

Average cost of—	Salaries.	Subsistence.	Illuminants.	Fuel.	Other supplies.	Incidentals.	Total maintenance.	Repairs and improvements.	Total.
District office, exclusive of third.	\$12,084				\$1,847	\$62	\$13,992		\$13,992
District depot, exclusive of third.	7,372				2,592	821	10,786	\$3,566	14,352
Large tender, Pacific.	23,397	\$6,341		\$13,935	3,386	208	47,267	3,029	50,896
Large tender, Atlantic.	19,591	6,135		9,073	3,781	221	38,800	3,121	41,921
Medium tender.	13,926	4,278		4,715	2,472	115	25,596	6,348	31,944
Exposed light vessel.	8,224	1,995	\$96	1,309	838	29	12,492	4,001	16,493
Moderately exposed light vessel.	4,569	1,290	125	366	414	7	6,772	1,168	7,940
Lake light vessel.	3,813	1,079	78	340	377	14	5,702	1,408	7,110
First-order light stations with powerful fog signals.	2,511	429	202	463	332	68	4,005	1,128	5,133
First-order light stations without fog signals.	1,802	319	147	107	180	78	2,633	347	2,980
Fourth-order light stations with powerful fog signal.	1,484	289	65	307	200	27	2,378	678	3,051
Fourth-order light stations without fog signal.	686	130	35	47	76	3	977	173	1,149
Lens lantern.	216	26	15	8	12	2	281	\$47	328
Minor light, river districts.	84		2		4		90	\$1	91
Minor light, other districts.	113		11		5	1	130	\$20	150
High-pressure acetylene light.	38	3	26	3	5	1	76	\$129	205
High-pressure acetylene buoy.			31		\$45		76	\$44	\$120
Oil-gas buoy.			32		\$28	1	61	\$19	\$80

\* Figures do not include cost of establishment of new aids.

† Figures include transportation charges of all kinds, such as freight on new buoys, etc.

‡ Figures do not include renewal of appendages.

## APPROPRIATIONS AND EXPENDITURES.

The appropriations for the maintenance of the Lighthouse Service for the fiscal year 1918 were \$5,338,680, being \$99,650 in excess of those for the preceding fiscal year. The estimates for maintenance appropriations for 1918 were divided into one appropriation for general expenses of supplies, repairs, etc., and three appropriations for salaries, with an alternative providing for all maintenance appropriations in a single item. This alternative proposition was not authorized by Congress. It is believed, however, that with this form of appropriation a more economical and efficient administration of the Lighthouse Service could be effected, and in the estimates for the next fiscal year attention has been drawn to the fact that if this consolidation is authorized a reduction of \$25,000 in the total estimates may be safely made. The appropriations for special works made for the fiscal year 1918 amounted to \$1,299,300. An appropriation of \$300,000 was also made to the United States Coast Guard for improved telephone coastal-communication systems, including connections to light stations, which will be of benefit to this Service.

The average appropriations for special works for the 10 preceding years, 1908 to 1917, inclusive, amounted to \$817,404.

The detailed estimates for the fiscal year 1919 are given on page 722. The total amount for general maintenance is \$1,458,150 more than the appropriation for the present year. Particular attention again is invited to the urgent need of the Lighthouse Service for additional funds. The cost of all materials has greatly increased, salaries and wages have been uniformly advanced, and in order that the Service

may be maintained at a proper standard of efficiency a corresponding increase in its appropriations is necessary. The Bureau desires to lay special stress on this matter, and under a separate heading includes a more detailed statement with reference to pay on vessels.

The estimate for the Bureau of Lighthouses in Washington is the same as the appropriation for the preceding year. Estimates for 20 special works have been submitted, aggregating \$1,931,000, considering only group 1, of which items amounting to \$317,000 are authorized by law. This is \$651,700 more than the appropriation for special works for the preceding year, and includes a number of important works for which estimates were submitted last year, but which were not included in the appropriations. The estimates include three new lighthouse tenders, one new light vessel, two new lighthouse depots, four items for establishing or improving aids in general localities, three items for a new system of harbor or channel lights and other aids, two items for improvements of light or fog-signal stations, four items for improvement of lighthouse depots, and one item for light-keepers' dwellings.

In selecting and submitting estimates for those special works believed to be most important, there were considered estimates submitted by officers in the various districts and others for new lighthouse and ship construction aggregating about \$5,600,000. Many items not included in the estimates for this year are thought to be meritorious, and the more important of them are included in group 2 of the estimates for special works, submitted for consideration as the resources of the Government permit them to be taken up. Explanation of the necessity for each of the items of special works is included with the estimates.

The tables following give comparisons of appropriations and expenditures for the Lighthouse Service, beginning with the fiscal year 1914 and including the estimates for 1919.

**APPROPRIATIONS, LIGHTHOUSE SERVICE, FISCAL YEARS 1914-1918, WITH ESTIMATES FOR 1919.**

[The salaries and allowances of officers of the Army on duty with the Lighthouse Service are not included in this table.]

Item.	Appropriations.					Estimates, 1919.
	1914	1915	1916	1917	1918	
MAINTENANCE.						
Salaries, Bureau of Lighthouses.....	\$64,510	\$64,030	\$64,030	\$64,030	\$64,030	\$67,000
Salaries of keepers of lighthouses.....	930,000	940,000	940,000	940,000	940,000	1,080,000
General expenses, Lighthouse Service.....	2,750,000	2,775,000	2,775,000	2,790,000	2,850,000	3,608,800
Salaries, Lighthouse vessels.....	967,420	997,800	1,010,000	1,070,000	1,104,650	1,650,000
Salaries, Lighthouse Service.....	360,000	375,000	375,000	375,000	380,000	391,000
Total for maintenance.....	5,071,930	5,151,630	5,164,030	5,239,030	5,338,680	6,796,830
Unexpended balances (obligations estimated).....	50,734	53,424	47,171	67,377	.....	.....
SPECIAL WORKS.						
New light and fog-signal stations.....	432,500	63,000	.....	193,000	155,000	.....
Light vessels.....	125,000	.....	.....	.....	280,000	160,000
Lighthouse tenders.....	.....	.....	250,000	20,000	210,000	600,000
Keepers' dwellings.....	.....	.....	.....	.....	.....	75,000
Improvement of aids.....	22,600	50,000	.....	726,000	612,300	443,600
Lighthouse depots.....	125,000	23,000	.....	50,000	21,000	653,000
Total for special works.....	722,600	136,000	250,000	999,000	1,279,300	1,931,000
Total maintenance and special works.....	5,794,530	5,287,630	5,414,030	6,238,030	6,617,980	8,727,830

## EXPENDITURES FROM APPROPRIATIONS, LIGHTHOUSE SERVICE, FISCAL YEARS 1913-1917.

[Actual expenditures, regardless of year of appropriation.]

Expenditures.	1913	1914	1915	1916	1917
For maintenance.....	\$5,037, 778	\$5, 166, 609	\$5, 111, 121	\$5, 002, 706. 25	\$5, 220, 473. 07
For special works.....	461, 627	538, 338	500, 516	748, 833. 50	651, 298. 99
Total.....	5, 499, 405	5, 704, 947	5, 611, 637	5, 751, 539. 75	5, 871, 772. 06

## DEPOTS.

The Lighthouse Service maintains 42 depots in the various districts for the storage and distribution of supplies and for other purposes. While these depots are not in themselves aids to navigation, they bear such a direct and important relation to the efficient maintenance of the latter that it is essential to provide them with adequate facilities. A number of items for depots are submitted in the estimates, some of which are repeated from previous annual reports, and three of which are authorized by law, though no appropriation has yet been made. Particular attention is invited to these cases, as follows:

In the second district the present depot at Lovells Island, Boston Harbor, is for a number of reasons unsatisfactory, and Congress has authorized the transfer for this purpose of the old marine-hospital site at Chelsea, Boston. This property was formerly under lease to private parties, but has been acquired by the Lighthouse Service, in an unimproved condition. A dock and storehouse are urgently needed. The act of August 28, 1916, authorized this work at a cost not to exceed \$85,000, but no appropriation of funds was made.

In the eleventh district estimates are submitted for repairs and improvements at the depot at Detroit, Mich. This work was also authorized by the act of August 28, 1916, but funds have not yet been appropriated. The authorized limit of cost is \$53,000.

In the nineteenth district the headquarters of the Lighthouse Service are at Honolulu, and storage facilities are either rented or granted by the courtesy of other branches of the Government. The establishment of a permanent depot in this district would facilitate the work of the Service, and estimates are submitted for that purpose. The act of August 28, 1916, authorized the establishment of a temporary depot on leased land at a cost not to exceed \$5,000 and also authorized the construction of a permanent depot at a limit of \$90,000, but no funds were appropriated for either object.

The act of July 1, 1916, contained an appropriation of \$50,000 for improvements at Woods Hole Lighthouse Depot, Mass. These funds have been used for dredging the channel and basin around the wharf and also for the erection of a brick storehouse, to replace the present timber structure, now nearing completion. The depot is well located for the work of the Service in the vicinity, and on completion of the proposed improvements will be very useful.

The new carpenter shop at the general lighthouse depot, Tompkinsville, N. Y., built under an appropriation of \$23,000 made by the act of August 1, 1914, is now completed and is of benefit in avoiding the fire hazard of the old frame building formerly used for that purpose, as well as providing a modern, well-lighted shop for all kinds of special woodwork used by the Service.

The act of June 12, 1917, appropriated \$21,000 for improvements of the offices and laboratory at the general depot. Plans and specifications for this work are now being prepared.

In the following districts provisions should be made for improved depot facilities:

An estimate is submitted for enlarging the machine shop at the general lighthouse depot at Tompkinsville, N. Y. The present machine shop is so constructed as to be unadaptable for the work it is now called upon to do, and it must be extended to be efficient for the great variety of work at this depot.

An estimate for a dry dock at the general depot is also submitted. The congested conditions prevailing at private shipyards and navy yards make it impossible to attend to the docking of lighthouse vessels at the proper intervals. Such a dock also would be of great value to other maritime services of the Department, and it is believed that considerable economy would thus result to the Government as a whole. An estimate for improvement of the wharves at the general depot is also submitted for the same reasons as stated above.

In the fifth district the present principal depot at Portsmouth, Va., is inadequate both in area and in water front, considering the size of the district and the number of lighthouse vessels to be accommodated. Estimate is submitted for enlarging this depot or establishing a new one.

The new lighthouse depot at Charleston, S. C., for which an appropriation was made by the act of October 22, 1913, has been completed so far as funds permitted and was occupied regularly for the first time on August 1, 1916. The old dock at Castle Pinckney was returned to the War Department January 8, 1917, after occupancy by the Lighthouse Service for nearly 39 years. Further improvements at Charleston Depot are needed, for which an estimate is submitted in group 2, for consideration when resources permit.

In the seventh district at Key West, Fla., the present depot property is on the grounds of the naval station and is surrounded by coal piers. The location is objectionable from the standpoint of caring for lighthouse supplies in a proper manner as well as interfering with the normal growth of the naval station. An estimate for a new depot, to relieve this situation, is submitted also in group 2.

The need for a depot at New Orleans, La., in the eighth district, has long been felt, and much unnecessary storage and lighterage expense has been incurred on this account. An estimate for this purpose also is included in group 2.

The present depot at Milwaukee, Wis., is practically surrounded by coal yards, and the coal dust is objectionable. Consideration is being given to obtaining a more suitable site.

In the sixteenth district, which in 1910 was organized as a separate lighthouse district, no permanent arrangement has yet been made for a depot, but temporary space is being rented at Ketchikan. A project has been submitted for consideration by Congress, as resources permit, for the purchase of a site and the necessary equipment for a lighthouse depot in Alaska.

In the eighteenth district figures are submitted, for consideration as resources permit, for repairs and improvements to the Goat Island Depot, Cal.

## LIGHTHOUSE TENDERS.

The tenders of the Service have been employed to good advantage during the year. The 50 vessels which have been in commission have steamed a total of about 464,000 nautical miles in their work of supplying light stations, maintaining the buoyage system, transporting construction materials, and carrying the officers and employees of the Service to their stations or on inspection duty.

Contract was awarded May 4, 1915, for the construction of the first-class seagoing lighthouse tender *Cedar*, for service in Alaska. The vessel was launched December 27, 1916; the official trials were satisfactorily completed June 12 and 13, 1917; the vessel was conditionally accepted June 30, 1917, and proceeded from Long Beach, Cal., to station at Ketchikan, Alaska, on July 11, 1917. Stops were made at San Francisco and Seattle for minor fitments and receiving cargo for lighthouse work and other Government services, and the vessel arrived at Ketchikan August 18, 1917.

A contract was awarded for the shallow-draft tender *Palmetto* on September 27, 1915, for service in the inland waterways of the sixth lighthouse district. The vessel was launched June 30, 1916, and completed March 19, 1917, being immediately assigned to duty in the district.

An appropriation of \$20,000 was made by the act of July 1, 1916, for a light-draft tender and barge for use in establishing and maintaining aids along the intercoastal waterways of Texas and Louisiana. Proposals have been twice advertised for this equipment without results. Therefore it has been necessary to defer action until conditions become more favorable.

With the increase in the number of aids to navigation and the deterioration of older vessels, it will be necessary to construct on an average one or two new tenders each year. The act of June 12, 1917, appropriated \$150,000 to replace the tender *Gardenia*, which has been surveyed and laid up as being of no further use to the Service. The same act appropriated \$60,000 for furnishing seagoing tenders with radio equipment. Work on these objects is now progressing.

Estimates have been submitted for three new lighthouse tenders to replace the present tenders *John Rodgers*, *Jessamine*, and *Holly*, or for general service, as may be found most desirable, at a cost of \$200,000 each. The vessels mentioned are all old, unseaworthy, side-wheel steamers, which should be laid up as soon as arrangement can be made.

The acquisition of the tender *Dandelion*, which went into commission April 7, 1917, for use on the upper Mississippi River, with the publication of soundings, channel reports, and other bulletins of interest to rivermen, has effected a decided improvement and has proven satisfactory to commercial lines operating on the river.

Copies of the Department's pamphlet entitled "Advisory Conference on the Subject of Making Passenger Vessels More Secure from Destruction by Fire" were distributed to the district officers and to each vessel in the Service.

Special instructions were issued relative to inspections of hoisting gear on lighthouse tenders, including all parts thereof, with a view of detecting any defect impairing their safety for handling cargo and

buoys, taking into consideration the increased sizes and weights now used.

A standard plan of draft marks for lighthouse vessels was prepared and issued during the year, with instructions for checking the draft marks already in place, and a standard report form covering the information desired at the periodical dockings of vessels was also distributed to the district officers.

The following tenders have either been extensively overhauled or such work has been started during the fiscal year 1917: *Lilac*, *Madrono*, *Maple*, *Larkspur*, and *Ivy*.

In the repair of vessels particular attention has been given to improvements which increase the comfort of the crew, and alterations with this end in view have been made on several tenders during the fiscal year.

It is probable that during the current year extensive overhaul will be completed or undertaken on the following tenders: *Mayflower*, *Holly*, *Iris*, *Azalea*, *Mangrove*, *Crocus*, *Marigold*, *Amaranth*, *Oleander*, *Pansy*, *Arbutus*, *Sumac*, and *Mistletoe*.

The following was the number of tenders of the Lighthouse Service on June 30 of the years specified, omitting vessels not having regular crews and those less than 50 feet in length: 1910, 51; 1911, 46; 1912, 45; 1913, 44; 1914, 45; 1915, 46; 1916, 47; 1917, 51. On June 30, 1917, the following was the status of the tenders: In actual service, 50; indefinitely laid up, 1; undergoing repairs, 0.

#### LIGHT VESSELS.

The Lighthouse Service maintains light vessels on 53 stations and has for this purpose 68 light vessels, of which 15 are relief vessels. Some of these vessels are old, 13 having been built over 50 years ago; one is 68 years old. Some of the older vessels are in a condition which does not warrant extensive repairs.

Contracts were awarded for the construction of second-class light vessels *No. 101* and *No. 102* on March 6, 1915. *No. 102* was launched November 27, 1915, accepted January 3, 1917, and was placed on station at Southwest Pass, entrance to Mississippi River, La., February 24, 1917. *No. 101* was launched January 12, 1916, accepted September 27, 1916, and was placed on station off Cape Charles, Va., October 4, 1916.

Plans and specifications have been completed and bids invited for construction of the new third-class light vessel *No. 99*, and a contract for construction was awarded June 29, 1916. Favorable progress was made by the builders up to July 10, 1917, when a fire of unknown origin destroyed the building ways and adjacent buildings at the shipyard, damaging the vessel beyond repair. The matter of rebuilding was at once taken up with the contractors, but the approximate time of completion can not be determined at present.

The balance of the appropriation remaining for light vessel *No. 100* is insufficient for the construction of the vessel, due to the high cost of materials, and consideration of the matter, therefore, has been deferred for the present.

The act of June 12, 1917, appropriated \$130,000 for a light vessel off Cape Charles or for general service and \$150,000 for light vessels

on the Great Lakes, where they are much needed to replace old vessels that should be withdrawn from duty. Work on the plans for these vessels was progressing at the close of the year.

An estimate is submitted for a new light vessel for the Gulf coast or for general service, which is greatly needed.

The work of reconstructing light vessel *No. 82*, referred to in previous annual reports, was completed in time for the vessel to go on station as a relief vessel for the Great Lakes during the fall of 1916, and has since been engaged in that work.

Careful attention has been paid in designing and remodeling light vessels to making all parts of such vessels accessible for cleaning and painting and to improvements for the comfort of the crew.

The following light vessels have either been extensively overhauled or such work has been started during the last fiscal year: *No. 39, No. 49, No. 52, No. 56, No. 60, No. 66, No. 67, No. 69, No. 70, No. 71, No. 84, and No. 88.*

It is probable that during the current fiscal year extensive overhaul will be completed or undertaken on the following light vessels: *No. 2, No. 4, No. 11, No. 16, No. 41, No. 42, No. 43, No. 51, No. 55, No. 68, No. 72, No. 80, and No. 97.*

The following was the total number of light vessels and stations on June 30 of the years named:

Year.	Light vessels.	Light-vessel stations.	Year.	Light vessels.	Light-vessel stations.
1910.....	68	54	1914.....	66	53
1911.....	63	51	1915.....	66	53
1912.....	65	51	1916.....	66	53
1913.....	67	53	1917.....	68	53

Of the present light vessels 38 have self-propelling machinery and 28 are provided only with sail power. Two have no means of propulsion.

On June 30, 1917, the following was the status of the light vessels: Regular vessels on station, 49; relief vessels on station, 4; relief vessels at depots, 7; regular vessels under repair, 4; relief vessels under repair, 4; relief vessels laid up, 0.

#### SALARIES AND WAGES ON LIGHTHOUSE VESSELS.

The greatest difficulty encountered in the efficient maintenance of the Service during the past two years has been the question of pay on lighthouse tenders and light vessels. As is well known, abnormal shipping conditions have been created by the European war, and former standard rates of pay on vessels have been completely discarded. For example, the present monthly pay of seamen in the Atlantic coast merchant marine (coastwise service) is exactly double the former standard wages, and proportional increases have been made in all other grades, including officers as well as crews. It is, therefore, quite apparent that the Lighthouse Service can not cope with such conditions by appropriations based on abandoned and inadequate pay scales.

The following table gives figures relating to the number of changes made in crews of lighthouse vessels during the fiscal year 1917:

Position.	Number authorized.	Number actually employed.	Ratio per position.	Position.	Number authorized.	Number actually employed.	Ratio per position.
Quartermasters.....	104	328	3.2	Stewards.....	35	50	1.7
Machinists.....	98	200	2.8	Cooks.....	114	325	2.8
Seamen.....	576	2,334	4.1	Mess attendants.....	82	405	4.9
Firemen, first class.....	187	789	4.2	Total.....	1,275	4,990	3.9
Firemen, second class.....	84	498	5.9				

The changes in senior officers have not been many, but those in junior positions, such as second officers and second assistant engineers of lighthouse tenders and mates and assistant engineers of light vessels, have been discouragingly numerous. For example, 81 persons filled 33 positions of junior deck officers, and 76 persons filled 33 positions of junior engineer officers, with corresponding ratios of men per position during the single fiscal year 1917 of 2.5 and 2.3, respectively.

This condition is of serious importance to the future well-being of the Service, as in the ordinary course of events these men would eventually be promoted to more responsible places, after the necessary experience in the manifold duties of the Service had been acquired.

Many deplorable situations have arisen in the past few years on account of insufficient pay—vessels have been tied up with urgent work remaining undone, or have gone to sea undermanned or partially manned by incompetent and unfit persons at serious risk to both life and property. Indeed, were it not for the commendable loyalty and fidelity to the Service displayed by the senior officers of these vessels, who have almost uniformly remained at their posts despite these discouraging circumstances, it is doubtful if the work accomplished could have been performed without some disaster to vessels of this Service or to merchant vessels by reason of lighthouse work being omitted or improperly executed. As it is, the annual relief of buoys, a most important obligation of the Service, strictly required by its regulations, has been falling behind, and this condition will speedily become acute and dangerous if not remedied at an early date. For example, in the calendar year 1915 it was not possible to relieve 148 buoys; in 1916 the corresponding figure was 336; and in 1917 the number will probably be much larger.

The inconvenience in operating with insufficient crews and constantly changing personnel to whom the duties were new has been very considerable and embarrassing to the Service, causing a serious handicap to efficient work, due to constantly breaking in green men of the low grade obtainable for the wages paid. By various make-shifts the vessels have been kept in commission except for relatively short periods and have performed such work as possible with the number and character of men obtainable. It is estimated that the loss of time due to delay in obtaining men and doing the work with short crews has caused a decrease in efficiency as to amount of work done of at least 20 per cent during the past year, not taking into



consideration the loss due to the inferior condition in which vessels are maintained or the hazard of attempting to proceed with dangerous duties with a short-handed and inefficient force. As the total annual operating expense of lighthouse vessels is about \$1,750,000, the direct financial loss may be set at about \$350,000 during the fiscal year 1917. A most disturbing aspect as to the future is disclosed by recent inspections of vessels, which clearly indicate that a general deterioration in upkeep has been suffered during the past two years from this cause. There is no doubt that the employment of incompetent crews has caused a large loss to the Government, due wholly to the lower wages paid on lighthouse vessels as compared with the merchant marine.

The Department has been fully aware of these conditions, which are by no means confined to this Service, and which have been encountered with equal force by other maritime services of the Government, and the Secretary has given the matter his close personal attention, by the appointment of a departmental marine board to consider such problems and in urging the necessity for greater appropriations. The 5 and 10 per cent increase authorized by Congress has, of course, been of benefit, but is quite insufficient to establish pay scales that will obtain the proper class of seafaring men.

In developing the detailed estimates submitted, the figures have been based on an agreement that was the result of negotiations between the Department of Labor, the Department of Commerce, the Shipping Board, and representatives of both employees and employers, which fixed a wage scale to remain in force until a year after the war ends. The details of this agreement were published in the Official Bulletin issued by the Committee on Public Information on August 11, 1917, and have been applied to the Lighthouse Service by the authority of the Secretary of Commerce. It is, therefore, earnestly recommended that the estimate as submitted be enacted into law, in order that the work of the Service may be properly carried out.

#### COOPERATION.

In accordance with the established custom of the Service, every effort has been continued to consult the needs of maritime interests and to cooperate effectively with other branches of the Government in matters relating to the work of the Lighthouse Service.

During the past year the most important work of this character has been the cooperation of the Lighthouse Service with the military branches of the Government on account of war conditions. The naval appropriation act of August 29, 1916, authorized the President, whenever in his judgment a sufficient national emergency exists, to transfer to the service and jurisdiction of the Navy Department or of the War Department such vessels, equipment, stations, and personnel of the Lighthouse Service as he may deem to the best interest of the country, and also provided that the Secretary of the Navy, the Secretary of War, and the Secretary of Commerce shall jointly prescribe regulations governing this condition. These regulations were issued April 11, 1917, and on the same date the President signed an Executive order transferring 30 lighthouse tenders to the War Department and 15 lighthouse tenders, 4 light vessels, and 21 light stations to the Navy Department. By July 1, 1917, all tenders

transferred to the War Department had been turned over to the Navy, which condition still obtains at the time of this report.

The Bureau has continued to cooperate with the Steamboat-Inspection Service in detailing employees for the purpose of making stability tests of a number of merchant vessels under examination by that Service, and has also designated, by authority of the Secretary of Commerce, deck officers of lighthouse tenders to assist in the examination under the Steamboat-Inspection Service of applicants for certificates as lifeboat men required by the recent seaman's act.

Cooperation was also rendered to the Bureau of Fisheries in inspections and supervision of repairs to vessels belonging to that service under direction of its representatives; and arrangements were also made, at the request of the Bureau of Fisheries, for catching sharks from light vessels on the South Atlantic and Gulf coasts, the skins to be used in experimental tanning work conducted by that bureau.

Arrangements were also made with the Weather Bureau, Department of Agriculture, to furnish that service certain meteorological observations made on selected light vessels and light stations. In the case of light vessels equipped with radio, these observing stations are particularly valuable, not only in obtaining forecast data for use of the Weather Bureau but also in distributing such forecasts to incoming and outgoing merchant ships.

The Forest Service, Department of Agriculture, continued to render valuable assistance to the Lighthouse Service in the matter of examinations and reports relating to timber on various lighthouse reservations, under authority of the act of March 3, 1915.

Measures were taken to furnish the Coast and Geodetic Survey with copies of monthly records showing the hours of operation of various important fog-signal stations. Further assistance was rendered the survey by the placing of special buoys for use in offshore surveying operations and by the detail of a technical employee on the trial board of a new steamer for that service.

The Navy Department, by letter of January 25, 1917, authorized the commandants of a number of navy yards and stations to issue, upon request of commanding officers of vessels of the Lighthouse Service, such articles of provisions as might be spared without detriment to the naval service, payment to be made by transfer of funds to the proper appropriations.

Arrangements were made with the office of the Chief of Engineers, War Department, relative to the display of lights and signals by persons or corporations obtaining permits from that department for building structures or work in navigable waters, and also on the subject of charges made by the Lighthouse Service for expenses incurred in the marking of wrecks or other menaces to navigation.

The Public Health Service rendered valuable assistance in the matter of sanitary advice, inspections, and fumigations at various stations and vessels of the Lighthouse Service, and also in the preparation of regulations governing the physical examination of keepers provided for in the act of August 28, 1916, which authorized free medical relief to that class of employees.

The Bureau of Mines continued to assist the Lighthouse Service in making analyses of coal, and detailed information was furnished that bureau, at its request, in reference to coal purchased by the Lighthouse Service on contracts providing for analysis.

**SAVING OF LIFE AND PROPERTY.**

During the fiscal year 1917 services in saving of life and property were rendered and acts of heroism performed by employees of the Lighthouse Service on vessels or at stations on 160 occasions, a list of which is given on page 708.

In each of these cases a commendatory letter was issued by the Secretary, and in the case of the work of the lighthouse tender *Cypress*, Capt. John P. Johnson commanding, during the hurricane in the vicinity of Charleston, S. C., July 13-15, 1916, a letter of commendation was also issued by the Navy Department. During this storm the services performed by the *Cypress* included the rescue of 97 marooned persons from a low island, the placing of two disabled lighthouse vessels in a safe anchorage, and the rescue of the master and 21 men from the wrecked naval collier *Hector*, off Cape Romain, under most difficult circumstances.

**REPORT OF OPEN-MARKET PURCHASES.**

In compliance with the act of June 17, 1910, there is submitted separately as a part of this report a list of purchases of materials and supplies for the Lighthouse Service made without obtaining bids under public advertisement, with the reasons for so purchasing.

**LEGISLATION ENACTED AFFECTING THE LIGHTHOUSE SERVICE.**

The following is a summary of special legislation affecting the Lighthouse Service enacted at the first and second sessions of the Sixty-fourth Congress and the first session of the Sixty-fifth Congress during the fiscal year 1917.

The deficiency act approved September 8, 1916, appropriated \$125,000 for repairing hurricane damage on the Gulf coast caused by the storm of July 5-6, 1916.

The deficiency act approved April 17, 1917, appropriated \$56.88 for adjudicated claims for damages for which vessels of the Lighthouse Service were found responsible.

The sundry civil act approved June 12, 1917, made the following appropriations: Lighthouse tender, third district or general service, \$150,000; Cape Charles, Va., light vessel, \$130,000; light vessels for the Great Lakes, \$150,000; aids to navigation, Pearl Harbor, Hawaii, \$80,000; improving office and laboratory at the general depot, Tompkinsville, N. Y., \$21,000; aids to navigation, Huron Harbor, Ohio, \$4,500; light station, Point Borinquen, P. R., \$85,000; rebuilding Chicago Harbor Light Station, Ill., \$88,000; aids to navigation, Fairport, Ohio, \$42,000; light and fog signal, Sand Hills, Lake Superior, Mich., \$70,000; improving light and fog signal, Manitowoc North Breakwater, Wis., \$21,000; improving aids, East River, N. Y., \$16,000; aid to navigation, Keweenaw waterway, Portage River, Mich., \$105,000; improving aids, Cape Charles City, Va., \$12,800; improving aids, eastern shore Chesapeake Bay, Md. and Va., \$29,000; aids to navigation, Alaska, \$60,000; aids to navigation, Indiana Harbor, Ind., \$100,000; improvements, Great Salt Pond Light Station, R. I., \$20,000; radio equipment, lighthouse tenders, \$60,000; and aids to navigation, Washington and Oregon, \$35,000. These objects were authorized by the acts of March 3, 1915, and August 28, 1916, which did not appropriate funds.

The sundry civil act of June 12, 1917, also contained an appropriation of \$300,000 to enable the United States Coast Guard to develop its present telephone system of coastal communication, including connections to important light stations which at present have no rapid means of communication.

The act of August 28, 1916, granted authority for the following purposes:

Exchange of rights of way of the United States in connection with lands pertaining to the Lighthouse Service for such other rights of way as may be advantageous to the Service, providing also for the payment of any expenses, not exceeding \$500, incurred by the United States in making such exchange, from the appropriation "General expenses, Lighthouse Service."

The establishment and maintenance, in the discretion of the Commissioner of Lighthouses, of post-lantern lights and other aids to navigation on the Mobile, Tombigbee, Warrior, and Black Warrior Rivers, Ala., and Lake Tahoe, Cal. and Nev.

The purchase, necessary equipment, repair, and operation of one motorcycle for the use of the Lighthouse Service in the Hawaiian Islands.

Medical relief for light keepers and assistant light keepers without charge at hospitals and stations of the Public Health Service, and providing also for certain physical examinations of persons who enter the Service hereafter.

The following works were authorized by the same act, at the limits of cost specified, but no appropriation of funds was made: Light-keepers' dwellings, \$75,000; lighthouse depot for second district, \$85,000; improvements at Detroit Depot, Mich., \$53,000; temporary depot at Honolulu, Hawaii, \$5,000; and lighthouse depot for nineteenth district, \$90,000. A number of other projects authorized in this act were appropriated for in the act of June 12, 1917, as mentioned in the list on page 717.

The naval appropriation act of August 29, 1916, authorized the transfer of portions of the Lighthouse Service to the War and Navy Departments under conditions as previously explained on page 676, and provided that the expenses of such transferred portions should be defrayed out of the appropriations of the department to which the transfer was made. This provision was subsequently amended by the naval deficiency act of June 15, 1917, which provided that the naval appropriations shall be available for expenses of the Lighthouse Service while cooperating with the Navy in so far as the regular appropriations for the Lighthouse Service are insufficient.

The employees' compensation act of September 7, 1916, provides, among other matters concerning payments to employees of the United States suffering injuries while in the performance of their duties, that such payments shall be made from the employees' compensation fund, instead of from salary appropriations of the Lighthouse Service as heretofore.

The act of February 14, 1917, referred the case of the British steamship *Esparta*, which on October 26, 1905, was in collision with the lighthouse tender *Magnolia* in the Mississippi River below New Orleans to the United States district court for the eastern district of Louisiana, with jurisdiction and authority to determine the liability of the United States.

The act of March 2, 1917, providing a civil government for Porto Rico, stipulated in section 6 thereof that the status of lighthouse work shall remain under Federal control as at present.

The legislative act of March 3, 1917, and the sundry civil act of June 12, 1917, provided for the Bureau and the field force of the Lighthouse Service, respectively, identical legislation for increased compensation during the fiscal year 1918 at the rate of 10 per cent per annum to employees receiving less than at the rate of \$1,200 per annum and at the rate of 5 per cent per annum to employees receiving not more than at a rate of \$1,800 per annum and not less than \$1,200 per annum.

The act of June 12, 1917, also provided that the limit of cost of construction of outbuildings at any one light station in any one fiscal year may be increased from \$200 to \$500, as recommended by the Department.

#### SPECIAL LEGISLATION NEEDED.

The following additional legislation for the Lighthouse Service is considered desirable:

The salaries of lighthouse inspectors are, by the act of June 17, 1910, limited to \$2,400 a year, except the inspector of the third district, whose salary is fixed at \$3,600. The salary of \$2,400 is inadequate because of the heavy responsibilities with which the inspector is charged and the technical and business ability required to successfully discharge the duties. The compensation of these positions should be sufficient to bring into and retain in the Lighthouse Service a class of persons fully competent to efficiently conduct such important work. The inspectors should be men of high character and qualifications, including technical knowledge as to engineering and nautical affairs, and should have business ability. It is recommended that the salary of inspectors be increased to not to exceed \$3,600 a year.

The salaries of lighthouse inspectors are materially less than those of various other officers of the Government whose requirements and responsibilities are not considered to be any greater. The Secretary of Commerce, at pages 145 and 146 of his annual report for the fiscal year 1915, described this situation fully, and attention is invited to his remarks on the subject. A provision for increasing the limit of salary of lighthouse inspectors was favorably considered by committees of both Houses of Congress, and was included in House bill 14338 as reported by the Committee on Interstate and Foreign Commerce April 15, 1916, and in Senate bill 21 as reported by the Committee on Commerce May 29, 1916, and as passed by the Senate July 27, 1916, all in the Sixty-fourth Congress, first session. The same provision is also included in House bill 2298 and in Senate bill 993 (65th Cong., 1st sess.). Reference is further made to the hearings on this subject on January 18, 1917, before the Senate Committee on Commerce. House bill 2298 was favorably reported by the Committee on Interstate and Foreign Commerce on September 21, 1917, but no action was taken owing to adjournment on October 6, 1917.

It is also recommended that a designation be given to the officers in charge of lighthouse districts which will more adequately indicate their duties than the present title of lighthouse inspector.

It is recommended that authority be granted to make the appropriation "General expenses, Lighthouse Service" available for the payment of traveling expenses and subsistence of teachers employed by States or private persons to instruct the children of keepers of lighthouses. The Bureau has endeavored to develop plans for the proper education of keepers' children at stations not accessible to schools, and in some States has been able to obtain the cooperation of the State educational authorities. It is believed that Government assistance in the matter of providing subsistence for such teachers while at stations would assist in promoting a worthy object at comparatively trifling expense.

It is recommended that the rate of commutation of rations to keepers and assistant keepers of the Lighthouse Service, fixed by the act of May 14, 1908, at 30 cents per day, be increased to 45 cents per day. Such an increase was authorized the United States Coast Guard by the act of June 12, 1917, and the extraordinary advance in the cost of foodstuffs, it is believed, makes a similar action in the Lighthouse Service fully justified.

The act of March 2, 1867, fixed the salaries of lighthouse keepers at not to exceed an average of \$600 per annum to each keeper. This rate has remained unchanged for over 50 years, and under present conditions it is practically impossible to attract and retain competent persons for this class of work at a salary so low. It is recommended, therefore, that the average pay be increased to \$700 per annum.

The Bureau, acting in cooperation with the Division of Publications of the Department and the Superintendent of Documents, Government Printing Office, has been endeavoring to devise some means whereby a nominal price may be placed on lighthouse publications, thus avoiding the present free and somewhat wasteful system of distribution. In arranging the details of this matter, business difficulties have arisen with private booksellers and agencies outside of the Government service, who decline to make the necessary returns of cash, stocks on hand, etc., unless a commission is allowed them on sales, following the usual commercial practice in this respect. Appropriate recommendations for legislation to overcome this difficulty, therefore, are submitted, providing for the sale of such publications with the allowance of commissions under proper regulations.

Recommendation is made that authority be granted to establish and maintain post-lantern lights and other aids to navigation, out of the annual appropriations for the Lighthouse Service, on Lakes Union and Washington, in the State of Washington. The lighting of inland waters is limited to those specifically authorized by Congress, and such authority has not been granted for the lakes specified. The Lake Washington Ship Canal, opened July 4, 1917, permits deep-sea shipping to enter these lakes, and in response to requests that lights be provided the foregoing recommendation is submitted.

It is also recommended that the appropriation "General expenses, Lighthouse Service" be made available for rebuilding light stations and depots and buildings connected therewith. Under present authority of law, if such a structure is completely destroyed by storm or other accident, its rebuilding can not be undertaken without the special authority of Congress, regardless of the extreme urgency of the case, and it is considered to be in the interest of effectively

maintaining the Lighthouse Service that provision for this purpose be made in the appropriation as recommended.

There is great need for provision by law for the retirement of employees of the Lighthouse Service who after long service have lost their ability for active duty by reason of age or disability incident to their work. This is essential to full efficiency in the administration of the Service. In the report for 1912 a statement was given showing the practice in a number of important foreign countries with reference to the pensioning of employees in the respective lighthouse services in common with other civil employees in those countries, from which it appears that a retirement system is in force with favorable results under all of the other governments mentioned. On April 24, 1916, the Senate unanimously passed a bill providing for the optional retirement of officers and employees of the Bureau of Lighthouses and the Lighthouse Service at the age of 65 years after 30 years' service, and compulsory retirement at the age of 70 years. The retirement pay would be at the rate of one-fortieth of the last annual pay for each year of active service, not to exceed thirty-fortieths. The bill was not acted upon by the House of Representatives and has been resubmitted in a modified form covering only field employees.

This action marked the first legislative step toward a system of retirement for the Lighthouse Service which has been earnestly recommended in previous annual reports every year since 1910. The bill had the warm indorsement of the Secretary of Commerce and of the Senate Committee on Commerce, and it is hoped that Congress may see fit to enact some remedial measure of this character into law at an early date.

The statistics as to the various classes of aids to navigation and fuller details on many of the subjects mentioned in this report will be found in the pages following.

Respectfully,

GEORGE R. PUTNAM,  
*Commissioner of Lighthouses.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*

# STATISTICS AND ESTIMATES.

## LIST OF OFFICERS OF THE BUREAU OF LIGHTHOUSES AND THE LIGHTHOUSE DISTRICTS.

### OFFICERS OF THE BUREAU OF LIGHTHOUSES ON JUNE 30, 1917.

George R. Putnam.....Commissioner of Lighthouses.  
John S. Conway.....Deputy Commissioner.  
H. B. Bowerman.....Chief Constructing Engineer.  
Edward C. Gillette.....Superintendent of Naval Construction.

Principal Assistant Engineer, Rudolph Zirpel.  
Inspector for general duty, E. M. Trott.  
Chief Clerk, Thaddeus S. Clark.  
Examiner, Thomas Flood.

### INSPECTORS IN CHARGE OF LIGHTHOUSE DISTRICTS JULY 1, 1916, TO JUNE 30, 1917.

District.	Name.	From—	To—
1st.....	C. E. Sherman.....	July 17, 1911	
2d.....	R. H. Goddard.....	June 27, 1912	
3d.....	J. T. Yates.....	June 20, 1912	
4th.....	T. J. Rout.....	Mar. 1, 1912	
5th.....	H. D. King.....	Jan. 28, 1915	
6th.....	H. L. Beck.....	Jan. 28, 1915	
7th.....	W. W. Dameritt.....	Aug. 22, 1913	
8th.....	B. B. Dorry.....	June 6, 1912	
9th.....	C. A. Lamy.....	Aug. 7, 1912	
10th.....	Roscoe House.....	June 4, 1912	
11th.....	E. L. Woodruff.....	Aug. 19, 1912	
12th.....	L. M. Stoddard.....	Aug. 16, 1912	
13th.....	Lt. Col. G. M. Hoffman, Corps of Engineers, U. S. Army. Maj. Gen. A. Mackenzie, U. S. Army, retired.	Oct. 16, 1913 May 29, 1917	May 29, 1917
14th.....	Col. Lansing H. Beach, Corps of Engineers, U. S. Army.	Aug. 10, 1915	
15th.....	Maj. Wildurr Willing, Corps of Engineers, U. S. Army. Lt. Col. C. S. Smith, Corps of Engineers, U. S. Army.	July 1, 1915 June 25, 1917	June 6, 1917
16th.....	W. C. Dibrell.....	Aug. 22, 1913	
17th.....	Robert Warrack.....	Feb. 1, 1915	
18th.....	H. W. Rhodes.....	July 6, 1912	
19th.....	A. E. Arledge.....	Sept. 3, 1912	

## JURISDICTION OF LIGHTHOUSE SERVICE.

The United States Lighthouse Service is charged with the establishment and maintenance of aids to navigation and with all equipment and work incident thereto on the sea and lake coasts of the United States, on the rivers of the United States so far as specifically authorized by law, and on the coasts of all other territory under the jurisdiction of the United States, with the exception of the Philippine Islands and Panama. The total length of coast line and rivers under the United States Lighthouse Service, measured by steps of 3 miles, is approximately 47,200 miles.

## LIMITS OF LIGHTHOUSE DISTRICTS.

*First district.*—Waters of Maine and New Hampshire.

*Second district.*—Waters of Massachusetts.

*Third district.*—Waters of Rhode Island, Connecticut, New York, and New Jersey northward of Cape May.

*Fourth district.*—Waters of Delaware seacoast and Delaware Bay and River.

*Fifth district.*—Waters of Maryland, Virginia, and North Carolina to New River Inlet, N. C.

*Sixth district.*—From New River Inlet, N. C., to Hillsboro Inlet, Fla.

*Seventh district.*—Waters of Florida from Hillsboro Inlet to Cedar Keys.

*Eighth district.*—Waters of Gulf coast from Cedar Keys, Fla., to mouth of Rio Grande River, Tex., and Mississippi River below New Orleans.

*Ninth district.*—Waters of Porto Rico and adjacent United States islands.

*Tenth district.*—United States waters of St. Lawrence River and Lakes Ontario and Erie.



*Eleventh district.*—United States waters of Lakes St. Clair, Huron, and Superior, and Detroit River.

*Twelfth district.*—Waters of Lake Michigan and Green Bay.

*Thirteenth district.*—Mississippi River above the mouth of the Missouri River, Minnesota, Illinois, Osage, Gasconade, and Missouri Rivers.

*Fourteenth district.*—Ohio, Tennessee, Kanawha, and Monongahela Rivers.

*Fifteenth district.*—Mississippi River below the Missouri River to New Orleans, La., and Red River.

*Sixteenth district.*—Waters of Alaska.

*Seventeenth district.*—Waters of Washington and Oregon.

*Eighteenth district.*—Waters of California.

*Nineteenth district.*—Waters of Hawaiian, Midway, Guam, and American Samoan Islands.

### LOCATION OF DISTRICT OFFICES OF THE UNITED STATES LIGHTHOUSE SERVICE, WITH ADDRESS OF THE LIGHTHOUSE INSPECTOR.

District.	Address.	District.	Address.
1st.....	Portland, Me., Y. M. C. A. Building.	11th.....	Detroit, Mich., Post Office Building.
2d.....	Boston, Mass., Customhouse.	12th.....	Milwaukee, Wis., Federal Building.
3d.....	Tompkinsville, N. Y.	13th.....	Rock Island, Ill., Federal Building.
4th.....	Philadelphia, Pa., Post Office Building.	14th.....	Cincinnati, Ohio, Customhouse.
5th.....	Baltimore, Md., New Customhouse.	15th.....	St. Louis, Mo., Customhouse.
6th.....	Charleston, S. C., Old Post Office Building.	16th.....	Ketchikan, Alaska.
7th.....	Key West, Fla.	17th.....	Portland, Oreg., Customhouse.
8th.....	New Orleans, La., Customhouse.	18th.....	San Francisco, Cal., Customhouse.
9th.....	San Juan, P. R.	19th.....	Honolulu, Hawaii, McCandless Building.
10th.....	Buffalo, N. Y., Federal Building.		

### LIGHTHOUSE DEPOTS MAINTAINED ON JUNE 30, 1917.

[The principal depot of the district is indicated by the larger type.]

District.	Location.	District.	Location.
1st.....	Bear Island, Me.	8th.....	Mobile, Ala.
2d.....	LITTLE DIAMOND ISLAND, ME.	9th.....	PORT EADS, LA.
3d.....	LOVELL'S ISLAND, BOSTON, MASS.	10th.....	Culebrita Island, P. R.
4th.....	Woods Hole, Mass.	11th.....	Guantanamo Bay, Cuba.
5th.....	Goat Island, R. I.	12th.....	SAN JUAN, P. R.
6th.....	Juniper Island, Vt.	13th.....	BUFFALO, N. Y.
7th.....	New London, Conn.	14th.....	Erie, Pa.
8th.....	TOMPKINSVILLE, STATEN ISLAND, N. Y.	15th.....	Maumee Bay, Ohio.
9th.....	Tucker Beach, N. J.	16th.....	Rock Island, N. Y.
10th.....	EDGEWOOD, DEL.	17th.....	Sandusky Bay (Cedar Point), Ohio.
11th.....	Lewes, Del.	18th.....	DETROIT, MICH.
12th.....	Annapolis, Md.	19th.....	Minnesota Point, Minn.
13th.....	Lazaretto Point, Md.	20th.....	St. Marys River, Mich.
14th.....	Point Lookout, Md.	21st.....	Charlevoix, Mich.
15th.....	PORTSMOUTH, VA.	22nd.....	MILWAUKEE, WIS.
16th.....	Washington Wharf, D. C.	23rd.....	St. Joseph, Mich.
17th.....	Washington, N. C.	24th.....	KETCHIKAN, ALASKA.
18th.....	CHARLESTON, S. C.	25th.....	Ediz Hook, Wash.
19th.....	Egmont Key, Fla.	26th.....	TONGUE POINT, OREG.
20th.....	KEY WEST, FLA.	27th.....	GOAT ISLAND, CAL.
21st.....	Fort San Jacinto, Galveston, Tex.	28th.....	HONOLULU, HAWAII.

### EXPLANATION OF TABLE ON PAGE 685.

The table of aids to navigation includes all those maintained by the Lighthouse Service, a total of 15,223. On page 692 are given facts regarding the private aids to navigation, 792 in number, maintained under authority. In the statistics relief light vessels are not counted and duplicate or auxiliary lights and fog signals are not counted, but double lights are counted separately when maintained on distinct structures or for distinct purposes. Buoys for the purpose of marking the positions of light vessels or larger buoys are not counted. Fog signals at light stations or on vessels are counted as separate aids, but not those attached to buoys, except in the case of submarine bells, which are counted as separate signals, whether on vessels or on buoys. Otherwise each buoy is counted only once, and if it is included in a higher class it is not in the lower class. Light-vessel lights are not counted separately.

## AIDS TO NAVIGATION MAINTAINED BY THE UNITED STATES LIGHTHOUSE SERVICE JUNE 30, 1917.

[See note on p. 684.]

Class.	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	9th dist.	10th dist.	11th dist.	12th dist.	13th dist.	14th dist.	15th dist.	16th dist.	17th dist.	18th dist.	19th dist.	Total.
<b>LIGHTED AIDS.</b>																				
<b>Hyper-radiant lights.</b>																				
First-order lights.	2	5	5	2	8	8	6	3				3							1	1
Second-order lights.	7	3	2	2		2	1	2	1			2					9	9	2	57
Third-order lights.	6	1	3	3		2	4	7	2			9				5	2	4	1	26
Three-and-one-half-order lights.																				67
Fourth-order lights.	35	25	53	10	40	2	1	12	2	21	46	37				4	18	20	8	232
Fifth-order lights.	19	15	13	6	22	2	1	12	2	9	16	12							1	133
Sixth-order lights.	1	5	21	2	8	1				10	4	16						2	1	72
Range-lens lights.																				46
Reflector lights.	2	7	1	13	0	31	12	7		6	27	4					2			121
Lens-lens lights.	12	22	53	15	45	64	29	161	14	37	90	46			89	23	37	41	703	2,970
Minor lights.	2	19	169	35	286	173	52	100	2				455	570	687	46	254	20	2	2,970
Electric lights, without lens.																				11
Lights on fixed aids.	1	11	10		8	4		2			1	5								53
Lights on floating aids.	6	45	51	14	52	6	5	27	6	31	78	17					1	3	2	387
Gas and whistle buoys.	7	5	11		10	8	5	9	1		1	1				5	11	8	5	72
Gas and aerial bell buoys.																				106
Float lights.		8	13	5	18	6	6	1		1	2	12	19					5	4	144
<b>Total.</b>	100	172	436	119	330	321	135	347	41	140	386	183	534	609	687	159	340	117	64	5,420
<b>Lights on fixed aids.</b>	86	103	346	100	442	297	119	308	33	96	287	135	455	570	687	145	316	95	58	4,578
<b>Lights on floating aids.</b>	14	69	90	19	88	24	16	39	8	44	99	48	79	39		14	24	22	6	742
<b>Total lighted aids.</b>	100	172	436	119	330	321	135	347	41	140	386	183	534	609	687	159	340	117	64	5,420
<b>UNLIGHTED AIDS.</b>																				
Fog signals, engine power.	19	21	37	5	15	4		3		10	38	47				10	23	28		290
Fog signals, clock power.	37	14	56	6	66	3	1	14		5	5	9				1	4	8		232
Fog signals, hand power.	12		2																	16
Fog signals, electric.																				20
Submarine signals.	2	5	4	1	4	5		3		1	5	4				1	4	2		51
Buoys, whistling (unlighted).	19	11	8		2	6	3	5												31
Buoys, bell (unlighted).	53	37	57	5	26	7	6	15	4		1	3				3	7	15	2	241
Buoys, iron (unlighted).	147	67	153	111	271	299	215	160	119	15	26	27				149	133	53	60	2,013
Buoys, spar (wood).	704	580	895	97	630	178	930	173		166	478	117	503			37	135	29	8	4,333
Daymarks, beacons, etc.	177	86	50	2	187	517	173	246	5		8	3	355	58		56	54	27	50	2,047
<b>Total unlighted aids.</b>	1,170	829	1,244	227	1,509	847	398	633	129	198	564	209	858	58		257	368	184	121	9,803
<b>Grand total.</b>	1,270	1,001	1,680	346	2,039	1,168	533	980	170	338	940	392	1,392	667	687	416	708	301	185	15,223

### DETAILS AS TO CHARACTERISTICS OF LIGHTS (NOT INCLUDING LIGHT VESSELS).<sup>a</sup>

	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	9th dist.	10th dist.	11th dist.	12th dist.	16th dist.	17th dist.	18th dist.	19th dist.	Total.
<b>Fixed white:</b>																	
Sixth order and above.....	30	30	52	18	57	25	4	27	6	22	30	22	5	4	2	4	338
Lights below the sixth order.....	2	8	83	12	228	133	46	139	4	5	64	6	35	193	17	17	992
Lighted buoys.....			5					2		2		5	2				18
<b>Fixed red:</b>																	
Sixth order and above.....	14	12	22	2	18	15	8	8	2	14	36	26		2		3	182
Lights below the sixth order.....	5	13	117	9	90	80	26	106	4	15	63	19	5	73	31	8	664
Lighted buoys.....			1	6				1	1	3		5					25
<b>Flashing or occulting:</b>																	
Sixth order and above.....	14	15	40	30	23	17	15	9	6	21	37	20	4	24	34	7	316
Lights below the sixth order.....	8	19	27	29	23	24	19	16	8	17	47	28	96	17	11	19	408
Lighted buoys.....	13	57	69	19	80	20	16	34	7	33	91	37	7	21	18	6	528
<b>Fixed and flashing, sixth order and above.....</b>	13	6	5		3	3	1	3	3	2	10	14		3			66
<b>Candlepower:</b>																	
50,000 to 190,000.....	5	4	4	4	4	7	5	5	3	2	7	1	1	2	9		63
200,000 to 490,000.....		1	2	1	1	1	1	1			3	1	1	1	2	1	17
500,000 and over.....		1	1													1	3
<b>Twin light stations.....</b>	2	3															5
<b>Stations with resident keepers.....</b>	70	51	112	33	89	24	12	49	17	35	77	70	11	34	39	15	738

### DETAILS AS TO ILLUMINANTS OF LIGHTS (NOT INCLUDING LIGHT VESSELS).<sup>a</sup>

	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	9th dist.	10th dist.	11th dist.	12th dist.	16th dist.	17th dist.	18th dist.	19th dist.	Total.
<b>Incandescent oil vapor.....</b>	30	27	39	19	18	15	11	12	10	8	38	30	2	27	29	5	320
<b>Oil (wick lamps):</b>																	
Sixth order and above.....	42	34	78	15	74	35	11	29	7	36	45	43	7	2	2	8	468
Lights below the sixth order.....	6	15	187	19	302	213	72	216	5	20	101	22	40	254	43	22	1,537
Lighted buoys.....									1	10	3	5	7				26
<b>Acetylene:</b>																	
Sixth order and above.....			1	10	6	10	4	6		11	9	6		2	1	1	67
Lights below the sixth order.....	8	19	37	29	23	24	19	45	5	15	21	28	95	12	9	19	408
Lighted buoys.....	6	26	33	5	28	20	13	8		20	7	7	16	7	6		202
<b>Oil gas:</b>																	
Lights with mantles.....										2	55						57
Lights without mantles.....					13				1		1	1					16
Lighted buoys with mantles.....	1	1	22	5	42			2	2	33	71	28		5	7		219
Lighted buoys without mantles.....	6	31	25	9	10		3	27	5			2			6		124
<b>Electric arc:</b>																	
Sixth order and above.....															1		1
Lights below the sixth order.....														2			2
<b>Electric incandescent:</b>																	
Sixth order and above.....			1	6	3		2			2	13	1		2	3		33
Lights below the sixth order.....	1	6	3	2	3				5	2	4	2	1	15	7	3	54
<b>Gas (coal), sixth order and above.....</b>		2										1					3
<b>Gas (oil), sixth order and above.....</b>												1					1

<sup>a</sup> Does not include the thirteenth, fourteenth, and fifteenth lighthouse (river) districts, in which there are 1,712 lights on fixed aids and 118 lights on floating aids, all of which use kerosene and are fixed, excepting 4, which use acetylene and are flashing, and 1 which uses electricity.

## DETAILS AS TO LIGHTS ON LIGHT VESSELS.

	1st dist.	2d dist.	3d dist.	5th dist.	6th dist.	8th dist.	10th dist.	11th dist.	12th dist.	17th dist.	18th dist.	Total.
<b>Characteristics as to lights:</b>												
1 fixed white light.....		3	1		1			4	4			13
2 fixed white lights.....		2	3	1		1				2	1	10
1 fixed red light.....									1			1
2 fixed red lights.....		2										2
1 fixed white and 1 fixed red light.....		1		3	1					1		6
1 white flashing, or occulting, and 1 fixed red light.....			2									2
1 white light, flashing or occulting.....	1	2	3	3	1	1	1	1	1		1	15
1 red light, flashing or occulting.....		1										1
2 white lights, flashing or occulting.....			1	1	1							3
<b>Illuminants:</b>												
Incandescent oil vapor.....		1				1						3
Acetylene.....	1		1	3	2							9
Oil (wick).....		7	4	3	1	1		4	5	3	1	29
Oil (wick) and acetylene.....			1									1
Oil (wick) and oil gas with mantle.....			1									1
Oil gas with mantle.....				1								1
Electric arc.....			1									1
Electric incandescent.....	1	2	1				1	1	1		1	8
<b>Illuminating apparatus:</b>												
Fourth order.....		1			1	1			1			4
Fifth order.....				1								1
Reflector.....		2	3	2	1		1	2		1		12
Reflector and lens lantern.....			2									2
Lens lantern.....	1	8	5	5	2	1		3	5	2	2	34

## DETAILS AS TO FOG SIGNALS.

Kind and how operated.	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	10th dist.	11th dist.	12th dist.	16th dist.	17th dist.	18th dist.	Total.
<b>Steam:</b>															
Whistle.....	8	5	6		5	2		1	3	30	31		3	6	100
Siren.....		1	1										1	1	4
<b>Air:</b>															
Whistle.....	1	5		1	1					5	5			1	13
Siren.....	2	3	23		5	1		1	4	7	10	5	6	16	84
Diaphone.....		1		1		1			3	1	1	1	2	4	14
Siren (electric).....									1	4			1	4	11
Reed horn.....	8	6	7	4	5			1				4	12		46
<b>Submarine bells:</b>															
On light vessels, driven by compressed air.....	1	7	7		7	3		2		3	4		3	2	39
On bottom, electric power.....										2					2
On buoys, operated by sea.....	1	1	2		1	2		1				1	1		10
<b>Bell:</b>															
Clockwork.....	37	14	59	6	66	3	1	14	5	5	9	1	4	8	232
Electric.....		5	4		3					3			1		16
Engine.....															1
Hand.....	12		2												14
Horn: Hand.....									1	1					2
Gun: Acetylene.....													1		1
<b>Total.....</b>	<b>70</b>	<b>48</b>	<b>111</b>	<b>12</b>	<b>93</b>	<b>12</b>	<b>1</b>	<b>20</b>	<b>16</b>	<b>56</b>	<b>61</b>	<b>12</b>	<b>35</b>	<b>42</b>	<b>589</b>

\* Auxiliary fog signals (76), whistling buoys (153), and bell buoys (347) are not included.

## LIGHTS ESTABLISHED DURING THE FISCAL YEAR 1917.

(223 lights.)

District.	Location.	Order.
7d.....	Canal Channel, No. 8, Buzzards Bay, Mass.....	Lens lantern (electric incandescent).
3d.....	Hunts Point, Long Island Sound, N. Y.....	Lens lantern (acetylene).
	Tuckerton Range, Little Egg Harbor, N. J. (2 lights).....	Lens lantern.
4th.....	Delaware City, Del.....	Minor (acetylene).
	Newcastle Range Front Auxiliary, Del.....	Lens lantern.
	Rancocas River Range, N. J. (2 lights).....	Minor (acetylene).
5th.....	Craighill Channel Range Rear Lower, Md.....	Lens lantern.
	Curtis Bay, Md.....	Minor.
	Fillbates Creek Flats, York River, Va.....	Do.
	Tarpley Point Shoal, Rappahannock River, Va.....	Do.
	Tunnel Island Spit, Pocomoke Sound, Va.....	Minor (acetylene).
6th.....	Bull Spit, Coosaw River, S. C.....	Do.
	Fenwick Island Cut, South Edisto River, S. C.....	Do.
	Marsh Island Spit, St. Helena Sound, S. C.....	Do.
7th.....	Steamboat Creek, No. 2, North Edisto River, S. C.....	Do.
	Cut G Range, Tampa Bay, Fla. (2 lights).....	Lens lantern.
	Cut K Range Front, Tampa Bay, Fla.....	Do.
	Cut K Range Rear, Tampa Bay, Fla.....	Reflector.
	Hillsboro Bay Range, Fla. (2 lights).....	Lens lantern.
	Hillsboro River Range, Fla. (2 lights).....	Do.
8th.....	Bestian Bay, La.....	Minor.
	Bayou Cook, La.....	Do.
	Bayou Courant, La.....	Do.
	Port O'Connor, Matagorda Bay, Tex. (2 lights).....	Do.
	Trinity River, Tex.....	Do.
	Vermillion River Entrance, La.....	Do.
9th.....	Cucaracha, Cucaracha Passage, P. R.....	Lens lantern (oil gas).
10th.....	Grand Island Range, Niagara River, N. Y. (2 lights).....	Range lens (acetylene).
	Oswego Inner, Oswego Harbor, N. Y.....	Lens lantern.
	Rob Roy Wreck, Lake Erie, Pa.....	Minor.
11th.....	Brush Point Range Front (auxiliary), St. Marys River, Mich.....	Lens lantern (oil gas).
	Fighting Island Channel, Detroit River, Mich.....	Minor.
	Fighting Island South, Detroit River, Mich.....	Lens lantern (acetylene).
	Old Channel, Lake St. Clair, Mich. (2 lights).....	Minor.
	Pipe Island Northwest, St. Marys River, Mich.....	Do.
	Pipe Island Southeast, St. Marys River, Mich.....	Do.
	Two Harbors West Breakwater, Mich.....	Lens lantern (acetylene).
12th.....	Portage Lake Pierhead, Mich.....	Fourth (acetylene).
	Racine North Pierhead, Wis.....	Minor.
	Sheboygan North Pierhead, Wis.....	Do.
	Wolf River Entrance, Wis.....	Do.
13th.....	25 lights.....	Do.
	11 lighted spars.....	Do.
	3 float lights.....	Do.
14th.....	6 lights.....	Do.
	1 float light.....	Do.
15th.....	93 lights.....	Do.
16th.....	Cape Edwards Entrance, Kukkan Bay, Alaska.....	Minor (acetylene).
	Cape St. Elias, seacoast, Alaska.....	Third (incandescent oil vapor).
	Hanin Rocks, Kodiak Harbor, Alaska.....	Lens lantern (acetylene).
	Lyman Point, Clarence Strait, Alaska.....	Minor.
	Point Craven, Peril Strait, Alaska.....	Do.
	Spike Rock, Wrangell Strait, Alaska.....	Do.
	Susitna River Entrance, Cook Inlet, Alaska.....	Lens lantern (acetylene).
	Turn Point, Hunter Bay, Alaska.....	Minor.
	Turn Point Shoal, Wrangell Strait, Alaska.....	Do.
	Village Point, Nichols Passage, Alaska.....	Do.
	Warm Spring Bay, Chatham Strait, Alaska.....	Do.
17th.....	Bone Island, Umpqua River, Oreg.....	Do.
	Cape Horn, Columbia River, Oreg.....	Do.
	Gillihan, Willamette River, Oreg.....	Do.
	Grays Bay, Columbia River, Wash.....	Do.
	Knapp Point, Columbia River, Oreg.....	Do.
	Lower Guide Wall, Salmon Bay, Wash.....	Minor electric incandescent).
	Slaughters, Columbia River, Wash.....	Minor (acetylene).
	Slaughters Bar, Columbia River, Wash. (7 lights).....	Minor.
	West Lock, Salmon Bay, Wash.....	Lens lantern (electric incandescent).
18th.....	Horseshoe Bend Cut, Sacramento River, Cal. (3 lights).....	Minor.
	San Diego Bay, Cal. (4 lights).....	Do.
19th.....	San Diego Bay, Cal.....	Lens lantern (acetylene).
	Kipahulu, Maui Island, Hawaii.....	Do.
	Kukui Point, Kauai Island, Hawaii.....	Do.

## LIGHTS WHERE ILLUMINATION WAS IMPROVED DURING THE FISCAL YEAR 1917.

## FLASHING OR OCCULTING LIGHTS CHANGED FROM FIXED LIGHTS (39 LIGHTS).

District.	Location.	District.	Location.
2d.....	Handkerchief Light Vessel No. 3, Nantucket Sound, Mass.	7th.....	Egmont Key Range Rear, Gulf coast, Fla.
3d.....	Blackwells Island Reef, East River, N. Y.		Hillsboro Bay, No. 2, Tampa Bay, Fla.
	Great Captain Island, Long Island Sound, Conn.	8th.....	East Bank, Galveston Harbor, Tex.
	Jones Rocks, Long Island Sound, Conn.		Hitchcock Reef, Galveston Harbor, Tex.
	Watch Hill, Fishers Island Sound, R. I.		Houston Channel, Tex. (6 lights).
4th.....	Marcus Hook Range Front, Delaware River, Del.		Port Arthur Canal, Tex.
	Murderkill River Range, Delaware Bay, Del. (2 lights).		Sabine Pass Channel, La.
5th.....	Cape Charles Light Vessel No. 101, seacoast, Va.		Sabine Pass East Jetty, La.
	Fishing Battery, Susquehanna River, Md.		Second Turn, Galveston Harbor, Tex.
	Lower Cedar Point Beacon, Potomac River, Md.	9th.....	Southwest Pass Light Vessel No. 102, La.
	Peristimon Point Shoal, Potomac River, Md.		Mayaguez Harbor Range, P. R. (2 lights).
	Porpoise Point, Chesapeake Bay, Md.	12th.....	Michigan City West Pierhead, Ind.
	Port Tobacco River Flats, Potomac River, Md.		New Shoal Gas and Bell Buoy, Straits of Mackinac, Mich.
6th.....	Brunswick Light Vessel No. 84, seacoast, Ga.		Northwest Entrance, Sturgeon Bay Canal, Wis. (2 lights).
			Pentwater Pierhead Range Rear, Mich.
		17th.....	Pully Point, Puget Sound, Wash.
			Slip Point, Juan de Fuca Strait, Wash.

## INCANDESCENT OIL-VAPOR LIGHTS CHANGED FROM OIL-WICK LIGHTS (17 LIGHTS).

2d.....	Hospital Point, Salem Harbor, Mass.	10th.....	Oswego, N. Y.
	Wood End, Cape Cod Bay, Mass.	12th.....	Chambers Island, Green Bay, Wis.
3d.....	Navasink, seacoast, N. J. (from electric arc).		Eagle Bluff, Green Bay, Wis.
	Saybrook Breakwater, Connecticut River, Conn.		Green Island, Green Bay, Wis.
4th.....	New Castle Range Front, Delaware River, Del.		Pilot Island, Lake Michigan, Wis.
8th.....	Southwest Pass Light Vessel, La. No. 102.		Plum Island Range Rear, Lake Michigan, Wis.
10th.....	Ashabula, Ohio (from acetylene).		Sherwood Point, Green Bay, Wis.
	Galloo Island, Lake Ontario, N. Y.	17th.....	St. Joseph Pierhead Range Rear, Lake Michigan, Mich.
			Slip Point, Juan de Fuca Strait, Wash.

## ACETYLENE OR OTHER LIGHTS CHANGED FROM OIL-WICK LIGHTS, ETC. (40 LIGHTS).

2d.....	Handkerchief Light Vessel No. 3, Nantucket Sound, Mass.	5th.....	Porpoise Point, Chesapeake Bay, Md.
3d.....	Blackwells Island Reef, East River, N. Y.		Port Tobacco River Flats, Potomac River, Md.
	Mill Rock Northerly, East River, N. Y.		35-Foot Channel Gas Buoys, Chesapeake Bay, Va. (2 lights).
	North Hook Beacon, New York Lower Bay, N. J. (electric).	6th.....	Brunswick Light Vessel No. 84, seacoast, Ga.
4th.....	Cherry Island Range Rear, Delaware River, Del. (electric).	7th.....	Hillsboro Bay, No. 2, Tampa Bay, Fla.
	Horseshoe Ranges West Group Lower Front, Delaware River, Pa. (electric).	8th.....	Houston Channel, No. 2, Tex.
	Horseshoe Ranges West Group Upper Front, Delaware River, Pa. (electric).		Sabine Pass East Jetty, La.
	Marcus Hook Range Front, Delaware River, Del.		Southwest Pass Range Front, La.
	Murderkill River Range, Del. (2 lights).	9th.....	Mayaguez Harbor Range, P. R. (2 lights; electric).
5th.....	Cape Charles Light Vessel No. 101, seacoast, Va.	10th.....	Strawberry Island Lower Cut Range, Niagara River, N. Y. (2 lights; acetylene to electric).
	Edenton Harbor Range, N. C. (2 lights; electric).	11th.....	Fighting Island Channel Gas Buoy, 6, Detroit River, Mich.
	Fenwick Island Shoal Light Vessel No. 52, seacoast, Del.		Grassy Island North Channel Range Rear, Detroit River, Mich. (oil-gas).
	Fishing Battery, Susquehanna River, Md.	12th.....	Michigan City West Pierhead, Ind.
	Lower Cedar Point, Potomac River, Md.		Northwest Entrance, Sturgeon Bay Canal, Wis. (2 lights).
	Peristimon Point Shoal, Potomac River, Md.		Pentwater Pierhead Range, Mich. (2 lights).
		17th.....	Pully Point, Puget Sound, Wash. (electric).
		18th.....	Goat Island, San Francisco Bay, Cal. (incandescent oil vapor to electric).
			Santa Cruz, seacoast, Cal. (electric).

## LIGHTS DISCONTINUED DURING THE FISCAL YEAR 1917.

[158 lights, including float lights.]

District.	Location.	Order.
2d.....	Canal Channel, Buzzards Bay, Mass. (10 lights).....	Lens lantern (acetylene).
4th.....	New Castle Range Front Auxiliary, Del.....	Lens lantern.
5th.....	Assateague Anchorage, Va.....	Do.
	Fishing Point, Assateague Anchorage, Va.....	Do.
	Fort Macon Spit, Beaufort Harbor, N. C.....	Minor.
6th.....	Fort Clinch Range, Cumberland Sound, Fla. (2 lights).....	Reflector.
	North Island, Winyah Bay, S. C.....	Lens lantern.
7th.....	Hillsboro Bay, No. 4, Fla.....	Do.
	Hillsboro Bay Entrance Range, Fla. (2 lights).....	Minor.
	South Cut Upper, No. 8, Tampa Bay, Fla.....	Lens lantern.
8th.....	Sand Island Range Rear, Mobile Bay, Ala. (2 lights).....	Lens lantern (acetylene).
10th.....	Oswego, N. Y.....	Third.
	Rob Roy Wreck, Pa.....	Minor.
11th.....	Ecorse Range Rear, Detroit River, Mich.....	Lens lantern (oil gas).
	Grassy Island South Channel Range Front, Detroit River, Mich.....	Lens lantern.
	Grosse Isle North Channel Range Front, Detroit River, Mich.....	Do.
	Mamajuda Range Front, Detroit River, Mich.....	Do.
12th.....	Indiana Harbor Range, Ind. (2 lights).....	Lens lantern (acetylene).
	Portage Lake Pierhead Range Front, Lake Michigan, Mich.....	Lens lantern.
	Portage Lake Pierhead Range Rear, Lake Michigan, Mich.....	Fourth.
13th.....	27 lights.....	Minor.
14th.....	5 lighted spar buoys.....	Do.
15th.....	5 lights.....	Do.
16th.....	68 lights.....	Do.
	Cape St. Elias, seacoast, Alaska.....	Lens lantern (acetylene).
	North Island Rock, Ores Inlet, Alaska.....	Minor.
	Spike Rock, Wrangell Strait, Alaska.....	Do.
	Sustina River Range, Ores Inlet, Alaska (2 lights).....	Do.
17th.....	Jetty Sands Range, Columbia River (2 lights).....	Do.
	Lower Willow Bar Range, Columbia River (2 lights).....	Do.
	North Side Channel Umpqua River, Oreg.....	Do.
	Slaughters Lower and Upper Ranges, Columbia River (3 lights).....	Do.
	South Channel Range, Columbia River (2 lights).....	Reflector.
	Three Tree Island Shoal, Columbia River.....	Minor.
18th.....	Humboldt Bay Entrance Range, Cal. (2 lights).....	Lens lantern.
	Mare Island Dike, No. 8, San Pablo Bay, Cal.....	No lens (electric incandescent).
	Mare Island, Cal.....	Fourth.

## GAS BUOYS ESTABLISHED AND DISCONTINUED DURING THE FISCAL YEAR 1917.

District.	Location.	District.	Location.
	<b>ESTABLISHED (73).</b>		<b>ESTABLISHED—continued.</b>
1st.....	Southeast Rock (whistle), seacoast, Me.	5th.....	Barge Tangler Wreck, York River Entrance, Va.
2d.....	Arthur James Wreck, Boston Harbor, Mass.		Barge Wreck, Curtis Bay, Md.
	Canal Channel, Buzzards Bay, Mass. (8 buoys).		Coronet Wreck, Chesapeake Bay, Md.
	Graves (whistle), Boston Harbor, Mass.		Florence O'Brien Wreck, Sassafras River Entrance, Md.
	Hercules Wreck, Boston Harbor, Mass.		Henry S. Lawson Wreck, Chesapeake Bay, Md.
	Marguerite Wreck, Boston Harbor, Mass.		Naval Target Wreck, Rappahannock Spit, Va.
3d.....	Conasconk Point Shoal, Raritan Bay, N. J.		Powhatan Wreck, Hampton Roads, Va.
	Grandma Coal Barge Wreck, Long Island Sound, Conn.		Powhatan Wreck (bell), Hampton Roads, Va.
	Popasquash Point (bell), Narragansett Bay, R. I.		Schooner Wreck, Chesapeake Bay, Md.
4th.....	Tunkhannock Wreck, seacoast, N. J.		Sewall Point Shoal (bell), Hampton Roads, Va.
	Ben Davis Point Shoal (bell), Delaware Bay, N. J.	7th.....	Key West (whistle), Fla.
	Cedar Creek, Delaware River, Del.		Miami, Fla.
	Hamburg, Delaware River, Del.		Seahorse Reef, Gulf coast, Fla.
	Middle Ground, Delaware River, Del.	8th.....	Brazos River, Tex.
	Pike Coal Barge Wreck, Delaware River, Pa.		Brazos River Entrance (whistle), Tex.
			Caucus Cut (whistle), Pensacola Bay Entrance, Fla.
			Middle Ground, Mobile Bay, Ala.

GAS BUOYS ESTABLISHED AND DISCONTINUED DURING THE FISCAL YEAR 1917—  
Continued.

District.	Location.	District.	Location.
	ESTABLISHED—continued.		DISCONTINUED—continued.
8th .....	Mobile Bar, Ala. (3 buoys).	2d .....	Hercules Wreck, Boston Harbor, Mass.
9th .....	Mobile Entrance (whistle), Ala.		Marguerite Wreck, Boston Harbor, Mass.
	West Bank, Mobile Bay, Ala.	3d .....	Grandma Coal Barge Wreck, Long Island Sound, Conn.
	Manchas Grandes, Mayaguez Harbor, P. R.		Tunkhannock Wreck, seacoast, N. J.
10th .....	San Augustin Shoal, San Juan Harbor, P. R.	4th .....	Ben Davis Point Shoal, Delaware Bay, N. J.
	Kelley Island Shoal North Side, Lake Erie, Ohio.		Middle Ground, Delaware River, Del.
	Shenango Wreck, Conneaut Harbor, Ohio.		Pike Coal Barge Wreck, Delaware River, Pa.
11th .....	Calcite, Lake Huron, Mich.	5th .....	Barge Ivie Wreck, Elizabeth River, Va.
	Fighting Island Channel, Detroit River, Mich. (2 buoys).		Barge Wreck, Curtis Bay, Md.
	Lake St. Clair, Mich. (2 buoys).		Coronet Wreck, Chesapeake Bay, Md.
	Pipe Island Shoal, St. Marys River, Mich.		Emma F. Angell Wreck, seacoast, Va.
	Pipe Island Twins, St. Marys River, Mich.		Florence O'Brien Wreck, Sassafras River Entrance, Md.
12th .....	Squaw Island, St. Marys River, Mich.		Henry S. Lawson Wreck, Chesapeake Bay, Md.
	Gravelly Island Shoal (bell), Lake Michigan, Mich.		Naval Target Wreck, Rappahannock Spit, Va.
	North Bank, Indiana Harbor, Ind.		Schooner Wreck, Chesapeake Bay, Md.
	Outer Shoal (bell), Lake Michigan, Wis.		Sewall Point Shoal (bell), Hampton Roads, Va.
16th .....	West Bank, Green Bay Harbor, Wis.		Shamokin Wreck, Hampton Roads Approach, Va.
	West Bank, Indiana Harbor, Ind.		Tarpley Point Shoal (bell), Rappahannock River, Va.
	Channel Rock, Sitka Sound, Alaska.		Tunnel Island (bell), Pocomoke Sound, Va.
	North Rock Shoal, Orca Inlet, Alaska.	7th .....	Key West, Fla.
	Orca Inlet, Prince William Sound, Alaska.		Port Inglis (whistle), Fla.
	Potter Rocks, Tongass Narrows, Alaska.	8th .....	Galveston Bay, Tex.
	Poundstone Rock (bell), Favorite Channel, Alaska.		Middle Ground, Mobile Bay, Ala.
	Reef Island Reef, Prince William Sound, Alaska.	10th .....	Shenango Wreck, Conneaut Harbor, Ohio.
17th .....	Clatsop Spit, Columbia River, Oreg.	11th .....	Fighting Island Channel, Detroit River, Mich.
	Duwamish Head (bell), Seattle Harbor, Wash.		Twenty-Foot Channel, Lake St. Clair, Mich. (4 buoys).
	Grays Harbor Outside Bar (whistle), Wash.		Watson Reefs, St. Marys River, Mich.
18th .....	North Spit (bell), Humboldt Bay, Cal.	12th .....	East Bank, Indiana Harbor, Ind.
	San Pablo Dredged Channel, San Pablo Bay, Cal. (2 buoys).		Middle Shoal, Lake Michigan, North End, Mich.
	DISCONTINUED (40).		West Bank, Indiana Harbor, Ind.
2d .....	Arthur James Wreck, Boston Harbor, Mass.	17th .....	South Jetty (whistle), Columbia River Entrance, Oreg.
	Canal Breakwater (bell), Cape Cod Canal Approach, Mass.	18th .....	City of Panama Wreck, San Francisco Bay, Cal.
	Canal Channel, Buzzards Bay, Mass. (3 buoys).		



### FOG SIGNALS ESTABLISHED, IMPROVED, AND DISCONTINUED DURING THE FISCAL YEAR 1917.

District.	Location.	Character.
<b>ESTABLISHED (7).</b>		
2d.....	Canal Channel, No. 8, Buzzards Bay, Mass.	Bell operated by electricity.
8th.....	Timballer, Gulfcoast, La.	Bell operated by machinery.
10th.....	Cleveland West Pierhead, Ohio.	Air diaphone.
11th.....	Eagle River Shoals, Lake Superior, Mich.	Electric siren.
12th.....	Manistique, Lake Michigan, Mich.	Air diaphone.
	Sheboygan Breakwater, Lake Michigan, Mich.	1st-class air siren.
16th.....	Cape St. Elias, seacoast, Alaska.....	Do.
<b>IMPROVED (15).</b>		
1st.....	Petit Manan, seacoast, Me.	From— 10-inch steam whistle. To— 10-inch air whistle.
2d.....	Handkerchief Light Vessel No. 3, Nantucket Sound, Mass.	Bell or horn (hand). Bell operated by machinery.
3d.....	Race Point, Cape Cod Bay, Mass.	Steam whistle. Air whistle.
4th.....	Race Rock, Block Island Sound, N. Y.	3d-class reed horn. 1st-class air siren.
	Fort Mifflin, Delaware River, N. J.	Bell operated by machinery. Electric air siren.
5th.....	Fort McHenry, Baltimore Harbor, Md.	Bell operated electrically. Electric air siren.
	Old Point Comfort, Hampton Roads, Va.	Bell operated by machinery. Bell operated by electricity.
8th.....	Southwest Pass Light Vessel No. 102, La.	12-inch steam whistle. 1st-class air siren.
10th.....	Ashtabula, Lake Erie, Ohio.	1st-class air siren. Air diaphone.
11th.....	Passage Island, Lake Superior, Mich.	Steam whistle. Do.
16th.....	Scotch Cap, Unimak Pass, Alaska.	10-inch air whistle. Do.
17th.....	Cape Flattery, seacoast, Wash.	Air siren. Do.
	Slip Point, Juan de Fuca Strait, Wash.	3d-class reed horn. Do.
18th.....	Farallon, seacoast, Cal.	Air siren. Do.
	Point Conception, seacoast, Cal.	Steam whistle. Do.
<b>DISCONTINUED (3).</b>		
10th.....	Cleveland West Breakwater, Ohio.	10-inch steam whistle.
12th.....	Sheboygan North Pierhead, Wis.	Do.
18th.....	Mare Island, Cal.	Bell operated by machinery.

### SUBMARINE SIGNALS DISCONTINUED DURING THE FISCAL YEAR 1917.

District.	Location.
12th.....	White Shoal, Straits of Mackinac, Mich.

### PRIVATE AIDS TO NAVIGATION MAINTAINED ON JUNE 30, 1917.

[Under the act of June 20, 1906.]

District.	Lights.	Buoys.		Other unlighted aids.	Fog signals.	Total.
		Lighted.	Unlighted.			
1st.....			33	3		36
2d.....	43		34	12		89
3d.....	28	6	95	8	2	139
4th.....		1	12			13
5th.....	16	6	120	68	3	213
6th.....			1			1
7th.....	4		9			15
8th.....	12		23	12		47
9th.....			3			3
10th.....	20	1	3	1	2	27
11th.....	13	2	54	1		70
12th.....	32	3	8		7	50
13th.....		1				1
14th.....	1					1
16th.....	2		1			3
17th.....	4		15		2	21
18th.....	23	2	2	1	10	38
19th.....	20		3	2		25
<b>Total.....</b>	<b>218</b>	<b>22</b>	<b>416</b>	<b>110</b>	<b>26</b>	<b>792</b>

## BRIDGES OVER NAVIGABLE WATERS LIGHTED ON JUNE 30, 1917.

[Under the act of Aug. 7, 1882, 22 Stat., 309.]

District.	Lighted bridges.	District.	Lighted bridges.	District.	Lighted bridges.
1st.....	19	8th.....	260	15th.....	8
2d.....	63	9th.....	1	17th.....	53
3d.....	181	10th.....	51	18th.....	29
4th.....	16	11th.....	53	Total.....	1,234
5th.....	152	12th.....	167		
6th.....	54	13th.....	75		
7th.....	24	14th.....	180		

## AIDS MAINTAINED UNDER CONTRACT DURING THE FISCAL YEAR 1917.

District.	Name of aids.	Annual cost.
1st.....	Kennebunkport Pier Light, Me.....	\$150.00
6th.....	Little River Inlet, N. C. (4 bar buoys).....	1.00
10th.....	Lake Ontario and the St. Lawrence River, N. Y. (41 buoys).....	1,900.00
	Niagara River and Black Rock Channel, N. Y. (74 buoys).....	600.00
11th.....	Superior Bay, St. Louis Bay and River, Wis. and Minn. (32 lights).....	2,200.00
12th.....	Fox River, Wis. (14 spar buoys); Green Bay, Wis. (18 spar and 2 gas buoys).....	160.00
16th.....	Cooks Inlet, Alaska (3 lights).....	93.00
	St. Michael Canal and Apoon Pass, Alaska (32 buoys), and Orizaba Reef Bell Buoy.....	388.50
	Norton Sound (12 lights).....	630.00
18th.....	Hookton Channel Range Rear Light, Cal.....	1.00

## LIGHT VESSELS IN COMMISSION DURING THE FISCAL YEAR 1917.

Number.	Station.	District.	Tonnage.		When built.	Material of hull.	Dimensions.			Regular complement.		Fog signal.	Illuminant.	Cost of repairs made during fiscal year.	Cost of maintenance during fiscal year.	Original cost.	On station.	
			Gross.	Net.			Length over all.	Breadth.	Depth.	Indicated horsepower (self-propelling).	Officers.	Crew.					Months.	Days.
74	Portland, Me.	1	495		1902	Wood	129 9	28 6	13 0	380	4	8	Acet.	\$1,817	\$10,134	\$88,896	10	24
3	Handkerchief, Mass.	2			1852	do.	69 4	23 0	10 0	(4)	1	5	do.	7,303	4,331	12,000	6	24
4	Relief	2	140		1855	do.	77 0	20 0	10 0	(4)	2	0	Oil.	1,244	2,946	12,000	7	2
5	Stone Horse Shoal, Mass.	2	104		1864	do.	80 6	21 6	9 0	(4)	2	7	8" air whistle.	6,633	6,272	10,400	10	4
6	Cross Rip, Mass.	2	120		1852	do.	80 0	24 0	10 0	(4)	2	7	do.	45	6,175	19,883	12	0
7	Hedge Fence, Mass.	2	104		1857	do.	81 2	28 2	9 6	(4)	2	7	Acet.	158	6,029	33,000	12	0
41	Vineyard Sound, Mass.	2	387		1876	do.	120 6	26 9	11 0	(4)	3	7	Oil.	382	6,506	33,000	12	0
42	Hen and Chickens, Mass.	2	410		1877	do.	121 7	26 6	11 0	(4)	3	7	10" air whistle.	116	8,359	40,796	12	0
47	Pollock Rip, Mass.	2	470		1891	Comp.	120 10	26 6	11 0	(4)	4	6	12" steam whistle.	3,282	9,131	60,000	11	18
54	Boston, Mass.	2	310		1892	Steel.	118 10	26 6	13 0	350	2	6	do.	964	10,837	62,030	11	16
66	Relief	2	590		1896	Comp.	123 0	28 6	13 0	400	4	8	Inc. o. v.	3,968	8,441	69,282	4	0
73	Pollock Rip Shoal, Mass.	2	693		1901	Steel.	123 9	28 6	12 9	400	4	8	Oil.	1,253	11,911	79,872	10	28
85	Nantucket Shoals, Mass.	2	683		246	do.	135 5	29 0	13 0	380	4	8	Oil.	4,752	15,149	99,000	8	1
86	Great Round Shoal, Mass.	2	683		1907	do.	135 5	29 0	13 0	380	4	8	do. b.	993	11,216	99,000	10	11
90	Relief	2	685		1908	do.	135 5	29 0	13 0	400	2	6	do. b.	896	8,432	107,213	8	16
11	Scotland, N. J.	3	320		1883	Wood	104 0	24 8	11 6	(4)	2	6	Oil and oil gas.	983	5,945	13,492	11	3
13	Bartlett Reef, Conn.	3	155		1854	do.	79 8	21 8	10 4	(4)	2	5	do.	30	5,066	12,000	12	0
16	Relief	3	250		1854	do.	103 6	22 6	11 0	(4)	0	1	First-class air siren, 6" whistle.	5,039	1,578	28,084	10	6
20	do.	3	165		1867	do.	81 6	21 6	10 0	(4)	0	1	do.	99	945	25,040	0	0
23	Ram Island Reef, Conn.	3	186		1857	do.	94 2	24 0	9 0	(4)	2	5	do.	1,141	7,500	7,500	12	0
39	Brenton Reef, R. I.	3	347		1875	do.	119 6	26 9	13 0	(4)	4	7	12" and 6" steam wh. b.	2,290	5,448	42,200	7	20
44	Northeast End, N. J.	3	197		1882	Iron.	115 6	25 0	10 6	(4)	4	7	First-class steam siren.	2,347	5,545	50,000	10	19
48	Cornfield Point, Conn.	3	470		1891	Comp.	120 10	27 8	12 0	(4)	3	7	First-class air siren.	2,347	8,134	52,780	11	2
51	Relief	3	283		1892	Iron.	118 10	26 9	11 0	325	2	5	12" steam whistle.	1,296	6,901	53,325	5	8
68	Five Fathom Bank, N. Y.	3	590		1897	Comp.	122 10	28 6	12 6	350	4	10	12" steam whistle.	2,402	13,032	74,750	8	15
69	Overfall, Del.	3	590		1897	do.	122 10	28 6	12 6	350	4	10	do.	25,283	12,852	76,500	5	27
78	Relief	3	668		1904	Steel.	129 0	28 6	13 0	325	2	5	12" steam whistle.	3,475	7,177	86,030	9	27
79	Five Fathom Bank, N. J.	3	668		1904	do.	129 0	28 6	12 6	325	4	8	12" steam whistle.	4,656	10,716	89,000	7	16
87	Ambrose Channel, N. Y.	3	683		1907	do.	128 5	29 0	13 0	325	4	10	12" steam whistle.	1,284	14,217	96,000	11	10

2	Relief.....	210	Wood.....	985 0	25 0	9 0	(4)	2	6	Bell.....	Oil.....	83	89	12,402	0
45	Thirty-Five Foot Channel, Va.....	265	Steel.....	124 6	27 6	12 0	(4)	2	6	6" air chime whistle b.....	do.....	783	6,007	68,900	12 0
5	Tail of the Horseshoe, Va.....	401	do.....	124 6	27 6	12 0	(4)	2	6	12" steam whistle b.....	do.....	712	8,562	68,900	11 4
5	Relief.....	470	Comp.....	120 0	27 0	14 0	(4)	2	3	do.....	do.....	20,785	8,150	57,900	4 8
52	Fenwick Island Shoal, Del.....	416	Iron.....	118 0	28 6	12 0	180	4	3	First-class air siren b.....	Acet.....	6,684	9,587	62,000	7 28
5	Diamond Shoal, N. C. O.....	204	Comp.....	122 0	28 6	13 0	350	5	10	12" steam chime wh. b.....	El. inc.....	7,323	12,332	70,700	9 9
72	Relief.....	693	Steel.....	123 6	28 6	14 0	350	5	10	do.....	do.....	5,714	11,932	89,000	9 9
5	Cape Lookout Shoals, N. C.....	668	do.....	129 0	28 6	12 0	400	4	10	do.....	do.....	1,661	11,363	85,000	11 0
91	Winter-Quarter Shoal, Va.....	685	do.....	135 5	28 6	13 0	400	4	8	do.....	Acet.....	1,675	11,091	107,213	9 21
5	Bush Bluff, Va.....	87	Comp.....	80 6	19 5	12 0	(7)	1	2	Bell.....	Oil gas.....	171	2,174	107,213	12 0
5	Cape Charles, Va.....	360	Steel.....	101 10	25 0	13 2	200	4	7	First-class air siren b.....	Acet.....	572	8,280	106,907	6 2
1	Martins Industry, S. C.....	275	Wood.....	103 0	24 0	13 0	(4)	2	8	do.....	Oil.....	1,348	7,326	.....	10 17
34	Charleston, S. C.....	1864	do.....	101 10	23 0	10 0	(4)	2	6	12" steam whistle b.....	do.....	1,258	5,268	49,000	8 16
53	Relief.....	310	Iron.....	119 0	26 6	11 0	335	3	5	12" steam whistle b.....	do.....	1,260	9,529	61,538	9 16
6	Brunswick, Ga.....	683	Steel.....	135 5	29 0	13 0	325	4	8	do.....	do.....	10,267	10,261	99,000	8 28
84	Frying Pan Shoals, N. C. O.....	670	do.....	135 6	29 0	13 0	363	4	10	12" steam chime wh. b.....	Inc. o. v.....	810	12,139	104,004	10 16
43	Relief.....	191	Comp.....	118 0	26 0	12 0	(4)	4	6	12" steam whistle b.....	Oil.....	335	6,429	50,000	5 13
81	Head Bank, Tex. O.....	668	Steel.....	129 0	25 6	12 6	325	4	7	do.....	do.....	2,642	11,273	90,000	8 17
8	Southwest Pass, La.....	900	do.....	101 10	26 0	13 2	200	4	8	First-class air siren b.....	Inc. o. v.....	199	5,727	110,965	4 5
9	Buffalo, N. Y.....	195	do.....	101 0	23 6	11 5	100	4	2	do.....	El. inc.....	766	5,480	87,025	7 4
61	Lake Huron, Mich.....	105	Wood.....	87 2	21 0	9 0	(4)	3	3	6" steam whistle b.....	Oil.....	340	4,254	14,068	6 15
62	Bar Point Shoal, Mich.....	105	do.....	87 2	21 6	8 0	(4)	3	3	do.....	do.....	800	4,404	14,068	6 0
11	Lake St. Clair, Mich.....	160	Steel.....	83 9	24 0	4 9	(4)	2	2	Bell.....	do.....	384	2,985	14,983	7 27
82	Relief.....	209	do.....	95 2	21 0	8 0	90	4	10	10" steam whistle.....	Acet.....	9,060	7,775	42,910	3 10
83	Martin Reef, Mich.....	71	do.....	88 3	21 0	10 0	90	4	10	6" steam whistle b.....	Oil.....	127	5,406	37,500	7 12
9	Poe Reef, Mich.....	170	do.....	101 0	23 6	11 5	(7)	3	3	First-class air siren b.....	El. inc.....	998	4,621	71,292	6 23
55	Leansing Shoal, Mich.....	129	Wood.....	102 8	20 0	9 0	100	4	2	6" steam whistle b.....	Oil.....	369	6,160	13,600	7 12
12	North Manitowish Shoal, Mich.....	130	do.....	102 8	20 0	10 0	100	4	2	do.....	do.....	7,798	5,265	13,600	6 18
12	Grays Reef, Mich.....	130	do.....	102 8	20 0	10 0	100	4	2	do.....	do.....	590	5,070	13,600	7 12
60	Eleven-Foot Shoal, Mich.....	105	do.....	87 2	21 6	8 0	(4)	3	3	10" steam whistle b.....	do.....	2,470	5,070	13,990	6 13
12	Peshigo Reef, Wis.....	155	Steel.....	75 0	21 6	4 0	(4)	2	3	8" air chime whistle.....	do.....	166	4,030	13,960	7 1
12	Milwaukee, Wis.....	268	do.....	108 5	23 0	10 2	200	4	5	12" steam whistle.....	El. inc.....	672	9,314	74,558	9 21
67	Umatilla Reef, Wash.....	364	Comp.....	122 7	26 6	13 0	200	4	10	do.....	Oil.....	285	14,020	66,750	9 24
92	Columbia River, Ore.....	683	Steel.....	135 5	29 0	13 0	325	4	10	do.....	do.....	2,688	13,611	96,000	8 12
82	Relief.....	245	do.....	135 5	29 0	13 0	400	2	5	do.....	do.....	2,109	12,105	107,213	8 24
98	Swiftnure Bank, Wash.....	685	do.....	135 5	29 0	13 0	400	4	11	do.....	do.....	1,329	15,515	107,213	9 0
70	San Francisco, Cal.....	570	Comp.....	122 10	26 6	13 0	349	4	11	do.....	El. inc.....	176	14,985	79,000	7 11
78	Relief.....	169	Steel.....	129 6	26 6	13 0	380	2	5	do.....	do.....	1,185	13,988	90,000	8 16
83	Blunts Reef, Cal.....	688	do.....	129 0	26 6	13 0	380	4	10	do.....	do.....	3,177	14,561	90,000	8 15

**Displacement (salt water).**

Submarine signal.

**c Length between perpendiculars.**

**Leasing Bail.**

• Wood sheathed.

**/ No means of propulsion.**

● Displacement (fresh water).

Ⓢ Equipped with radio.

## TENDERS OF THE LIGHTHOUSE SERVICE IN COMMISSION DURING THE FISCAL YEAR 1917.

Name.	District.	Displacement.		When built.	Description.	Material of hull.	Dimensions.			Mean draft.		Indicated horsepower.	Regular complement.		Miles steamed.	Coal consumed for all purposes.	Cost of repairs.	Cost of maintenance.	Original cost.
		Light.	Tons.				Length over all.	Breadth.	Depth.	Light.	Loaded.		Officers.	Crew.					
Hibiscus.....	1	818	1,081	1908	Steamer, twin screw.	Steel.	190	30	16	11 0	16 3	1,000	6	25	16,754	2,117	\$2,261	\$42,343	\$184,643
Zinnia.....	1	575	643	1888	do.	Iron.	161	27	12	8 9	9 0	660	5	22	9,914	1,125	3,473	32,587	48,739
Anemone.....	2	818	1,043	1908	do.	Steel.	190	30	16	11 0	13 0	1,000	6	25	12,956	1,719	1,733	40,553	191,999
Arakia.....	2	330	516	1891	Steamer, single screw.	do.	154	28	12	6 6	9 0	400	5	21	11,174	1,014	2,017	30,072	79,792
Mayflower.....	2	630	668	1897	Steamer, twin screw.	do.	164	30	12	7 9	8 1	660	5	24	10,306	1,836	2,814	33,860	74,572
Delany.....	3	61	84	1892	Steamer, single screw.	Wood.	80	14	5	4 0	5 0	60	2	4	8,154	157	697	7,357	6,500
Gardnia c.....	3	217	245	1879	do.	do.	417	20	9	6 0	6 0	200	4	11	6,831	377	515	12,380	11,000
John Rodgers.....	3	455	571	1883	Steamer, side wheel.	Iron.	160	27	9	6 6	7 9	260	4	18	5,821	650	1,901	21,483	69,997
Leopold.....	3	738	888	1903	Steamer, twin screw.	Steel.	189	30	14	9 1	10 10	760	6	24	7,041	1,54	403	10,143	123,269
Mielcke.....	3	455	476	1873	Steamer, side wheel.	Wood.	160	26	9	6 6	7 9	270	4	18	7,031	635	1,448	20,214	48,833
Penny.....	3	431	454	1873	Steamer, twin screw.	do.	152	28	11	7 7	7 11	250	4	19	12,572	1,042	2,100	23,019	48,739
Tully.....	3	774	1,142	1908	do.	Steel.	190	30	16	10 7	13 0	1,000	6	25	15,155	2,269	2,269	35,770	191,483
Myrtle.....	3	435	542	1872	Steamer, single screw.	Wood.	140	28	11	9 6	11 0	225	4	17	14,680	1,239	5,833	26,388	44,500
Iris.....	4	519	606	1897	do.	Steel.	153	30	10	8 7	9 6	800	4	19	10,138	1,250	5,493	27,419	84,407
Woodbine.....	4	85	107	1913	Gasoline, single screw.	Wood.	96	16	7	5 2	5 11	125	2	4	7,837	14,997	1,983	10,279	24,728
Arbutus.....	5	398	545	1879	Steamer, twin screw.	do.	153	25	11	7 0	9 0	380	5	16	8,901	878	2,080	27,998	49,769
Holly.....	5	431	499	1881	Steamer, side wheel.	Comp.	176	24	10	7 0	8 0	400	5	20	9,970	757	1,140	21,244	41,911
Jessamine.....	5	369	443	1881	do.	Iron.	156	24	10	7 3	7 9	350	4	16	7,532	760	1,018	20,280	41,911
Juniper.....	5	125	146	1903	Steamer, twin screw.	Steel.	95	18	8	4 6	5 0	260	2	9	5,944	368	5,631	29,436	55,502
Laurel.....	5	218	299	1915	Steamer, single screw.	Wood.	105	22	9	6 6	6 10	180	4	11	9,155	396	2,648	14,184	55,502
Maple.....	5	567	799	1883	Steamer, twin screw.	Steel.	164	30	12	7 3	9 0	650	6	22	11,325	1,319	8,332	30,602	98,889
Orchid.....	5	818	1,081	1908	do.	do.	190	30	16	11 0	13 3	1,000	7	25	16,981	2,103	8,170	36,555	186,151
Cypress.....	6	716	1,060	1908	do.	do.	190	30	16	10 1	13 1	1,000	7	25	18,191	2,174	4,167	42,480	191,633
Mangrove.....	6	649	652	1897	do.	do.	164	30	12	7 0	8 8	550	5	24	12,746	1,839	3,267	32,638	74,996

Palmetto.....	6	156	166	1917	Gasoline, twin screw.....do.....	90	22	8	3	8	3	11	150	3	8	2,066	{45,005 4	63	5,574	27,687
Water Lily.....	6	29	39	1895	.....do.....	64	11	5	2	11	3	8	36	2	2	5,800	{43,780 4	6	5,274	9,261
Ivy.....	7	736	916	1904	Steamer, twin screw.....	173	30	13	8	5	9	6	700	5	22	3,806	553	46,108	20,637	123,860
Snowdrop.....	7	30	41	1896	Gasoline, twin screw.....	69	11	5	3	1	3	7	32	2	2	5,383	{44,310 2	1,043	4,915	9,700
Camellia.....	8	276	377	1911	Steamer, twin screw.....	117	24	10	5	10	7	7	280	4	17	5,223	617	221	19,538	57,412
Magnolia.....	8	685	877	1904	.....do.....	173	30	13	7	6	9	2	700	5	24	12,686	1,954	1,384	31,992	124,874
Sunflower.....	8	728	886	1907	.....do.....	174	31	15	9	8	13	1	900	6	26	9,850	1,516	5,123	34,091	124,958
Lilac.....	9	464	643	1892	Steamer, single screw.....	155	27	15	10	6	12	3	800	5	19	4,924	510	15,895	5,129	92,125
Crocus.....	10	/981	/1,000	1904	Steamer, twin screw.....	165	29	14	9	6	10	6	700	6	21	7,866	1,577	3,728	27,388	119,718
Amaranth.....	11	/597	/775	1892	Steamer, single screw.....	196	28	14	8	6	12	6	672	5	20	9,413	1,280	3,110	27,342	74,994
Aspen.....	11	/583	/415	1906	.....do.....	126	25	12	7	3	8	3	440	4	10	8,695	1,400	1,507	15,507	70,573
Olive.....	11	/163	/206	1899	.....do.....	93	22	7	5	4	6	4	140	4	8	9,914	378	607	12,626	37,973
Marigold.....	11	/477	/696	1890	.....do.....	180	27	12	8	5	11	0	550	5	20	11,751	937	1,459	26,553	84,871
Hyacinth.....	12	/483	/914	1903	.....do.....	165	28	14	7	0	11	6	500	5	20	7,896	1,275	3,658	26,849	115,000
Sunac.....	12	/600	/887	1903	Steamer, twin screw.....	169	30	13	8	5	11	9	700	5	23	8,494	1,450	2,835	32,248	114,992
Dandelion.....	13	/232	/302	1883	Steamer, stern wheel.....	140	31	5	2	6	3	3	500	4	13	1,199	399	.....	4,834	23,174
Goldenrod.....	14	/194	/283	1888	.....do.....	169	27	4	2	5	3	4	152	.....	.....	.....	.....	.....	.....	33,221
Oleander.....	15	/463	/648	1903	.....do.....	189	34	7	3	10	4	6	600	3	17	15,613	2,234	878	26,271	60,000
Kukul.....	16	838	935	1908	Steamer, twin screw.....	190	30	16	11	2	12	0	1,000	7	22	12,760	2,543	5,122	58,238	213,880
Fern.....	16	245	317	1915	Steamer, single screw.....	112	22	10	7	1	8	6	300	4	8	12,573	3,108	3,800	18,005	62,100
Cedar.....	16	1,245	1,980	1917	.....do.....	201	36	18	9	6	13	6	1,455	7	22	.....	.....	.....	.....	248,196
Heather.....	17	631	831	1903	.....do.....	179	28	15	9	6	11	6	685	6	19	8,685	1,181	4,366	32,010	118,568
Manzanita.....	17	774	1,000	1908	Steamer, twin screw.....	190	30	16	10	7	12	7	1,000	6	23	10,771	1,432	5,094	35,952	211,817
Rose.....	17	395	567	1916	.....do.....	127	24	11	7	0	9	4	330	4	16	6,940	1,077,522	728	20,287	92,135
Madrona.....	18	664	806	1885	Steamer, single screw.....	180	27	15	9	9	11	6	750	6	19	9,697	1,124	1,923	36,273	87,872
Sequoia.....	18	909	1,100	1908	Steamer, twin screw.....	190	30	16	10	11	13	5	1,000	7	23	10,460	1,351	662	45,427	213,499
Columbine.....	19	429	643	1892	Steamer, single screw.....	155	27	15	9	6	12	3	800	6	19	9,254	800	4,155	36,317	93,993

\* Light—without cargo and deck loads, and a minimum supply of stores, provisions, water, and coal or oil.

\* Loaded—bunkers or fuel-oil tanks full of coal or oil, all tanks, including trimming tanks, full of water; full stores and provisions, and an average maximum cargo and deck load.

g In use by U. S. Engineer Department.

a Gallons of fuel oil.

† Placed in commission June 30, 1917.

⊙ Equipped with radio.

a Laid up Mar. 1, 1917.

a Length between perpendiculars.

e Gallons gasoline.

f Displacement (fresh water).

## CONSTRUCTION OF TENDERS AND LIGHT VESSELS.

*Tender "Palmetto."*—Acts of May 27, 1908, and March 4, 1909, appropriated \$200,000 for one tender, and the acts of July 27, 1912, and March 3, 1915, authorized the use of this amount for the construction of two or more tenders for general service. Plans were prepared for a light-draft tender for use in the inside waters of the sixth district, and on September 3, 1915, a contract was awarded to the Merrill-Stevens Co., Jacksonville, Fla., in the sum of \$28,975. The vessel was launched June 30, 1916, and was completed and placed in commission March 19, 1917. Amount expended to June 30, 1917, \$27,687.20.

*Tender.*—The act of May 27, 1908, appropriated \$30,000 for a tender for the engineer sixth lighthouse district or elsewhere. Expenditures for plans under this appropriation amounted to \$3,133.36, but owing to the rapid advance in the cost of labor and material it was found impossible to construct a vessel from the available balance. Bids were invited for the purchase of a suitable vessel for use in the thirteenth district, and a contract was entered into on March 7, 1917, for the purchase of the stern-wheel river steamer *F. Weyerhaeuser*, at a cost of \$19,300. The vessel was placed in commission April 6, 1917, and renamed *Dandelion*. Amount expended to June 30, 1917, \$23,173.90 for tender *Dandelion*. Total expended from appropriation, \$26,307.26.

*Tender "Rose."*—Acts of May 27, 1908, and March 4, 1909, appropriated \$200,000 for one tender, and the act of July 27, 1912, authorized the use of this amount for the construction of two tenders for general service. As one of these, plans and specifications were completed for a tender of moderate size and draft for use in the small harbors and inside waters of the coasts of Oregon and Washington, and on November 6, 1914, a contract was awarded for its construction to Anderson Steamboat Co., Seattle, Wash., in the sum of \$87,950. The vessel was launched February 19, 1916, and was completed and placed in commission August 8, 1916.

*Tender "Cedar."*—The act of January 25, 1915, appropriated \$250,000 for a light-house tender for general service. Plans and specifications were immediately prepared for a first-class seagoing tender, for service in Alaska, and on May 4, 1915, a contract was awarded for its construction to the Craig Shipbuilding Co., Long Beach, Cal., in the sum of \$234,500. The vessel was completed and placed in commission June 30, 1917. Amount expended to June 30, 1917, \$245,443.88.

*Tender "Aster" and barge.*—The act of July 1, 1916, appropriated \$20,000 for constructing or purchasing and equipping a small tender and barge for the eighth district, Texas and Louisiana. It was proposed to purchase a suitable vessel for a tender, and construct the barge from plans and specifications now in preparation. Bids were twice invited for the purchase of a suitable vessel, without satisfactory results owing to the scarcity of vessels caused by war conditions. It is proposed to invite bids again when conditions become more normal. Amount expended to June 30, 1917, \$13.14.

*Power derrick barge.*—The act of July 1, 1916, appropriated \$100,000 for aids to navigation, Hudson River, N. Y. It was found that in the construction of these aids a light-draft power barge with derrick was required. A suitable barge available for purchase could not be found, and accordingly plans and specifications were prepared for a wooden power derrick barge, and on January 13, 1917, a contract was awarded to Rice Bros., East Boothbay, Me., for its construction, in the sum of \$29,400. The keel, stem, sternpost, and frames were partly completed when, on July 10, 1917, a disastrous fire occurred at the plant of the above concern, destroying all but four frames, the keel, stem, and sternpost being uninjured.

*Radio equipment for seagoing vessels.*—The act of August 28, 1916, authorized the furnishing of all seagoing vessels in the Lighthouse Service with radio equipment and auxiliary power for the operation thereof, at a cost of \$60,000, and the act of June 12, 1917, appropriated \$60,000 for the purpose. Steps have been taken, in cooperation with the Navy Department, to purchase the apparatus and equip all seagoing tenders of this Service. The apparatus has been ordered, and the work of installation will probably be completed by January 1, 1918.

*Tender.*—The act of June 12, 1917, appropriated \$150,000 for a lighthouse tender for the third district to replace the tender *Gardenia* or for general service. Plans and specifications are in preparation, but no expenditures were made to June 30, 1917.

*Light vessel "No. 99."*—The act of August 24, 1912, appropriated \$130,000 for a light vessel for general service. Plans and specifications were prepared for a light vessel for the Great Lakes. Bids were received on May 25, 1916, and on June 29, 1916, a contract was awarded to Rice Bros., East Boothbay, Me., in the sum of \$61,000. Amount expended to June 30, 1917, \$28,329.42. The construction of the vessel had reached a degree of completion of approximately 53 per cent on June 30, 1917. On July 10, 1917, a disastrous fire occurred at the builders' plant in which the vessel and the greater part of its fittings were rendered a total loss.

*Light vessel "No. 100."*—Plans and specifications are in preparation for a large light vessel for station at Nantucket Shoals, Mass. There is a balance of approximately \$51,600 remaining under the appropriation of August 26, 1912, for light vessels, but on account of the present excessively high cost of materials it will not be possible to construct the vessel from this available balance. No expenditures were made to June 30, 1917.

*Light vessel "No. 101."*—Act of August 26, 1912, appropriated \$250,000 for light vessels for general service. Plans and specifications were prepared for a second-class vessel for general relief duty on the Atlantic coast, to be assigned to the light-vessel station off Cape Charles, Va., and on March 6, 1915, a contract was awarded for its construction to the Pusey & Jones Co., of Wilmington, Del., in the sum of \$93,699. The vessel was launched January 12, 1916, and was completed and placed on station October 4, 1916.

*Light vessel "No. 102" (Southwest Pass).*—The act of October 22, 1913, appropriated \$125,000 for a light vessel for the Southwest Pass entrance to the Mississippi River, La. Plans and specifications for a vessel generally similar to *No. 101* were prepared, and on March 6, 1915, a contract was awarded for its construction to the Pusey & Jones Co., of Wilmington, Del., in the sum of \$93,699. The vessel was launched November 27, 1915, and was completed and placed on station February 24, 1917.

*Light vessels "No. 103" and "No. 104."*—The act of June 12, 1917, appropriated \$150,000 for light vessels for general lake service. Plans and specifications for two vessels similar in construction to light vessel *No. 99* are now in preparation. No expenditures were made to June 30, 1917.

*Light vessel "No. 105" (Cape Charles).*—The act of June 12, 1917, appropriated \$130,000 for a light vessel for Cape Charles, Va. A preliminary design has been started. No expenditures were made to June 30, 1917.

#### SPECIAL WORKS OF CONSTRUCTION COMPLETED (OMITTING VESSELS).

*Oil houses for light stations.*—The acts of May 27, 1908, March 4, 1909, and June 25, 1910, each appropriated \$10,000 for establishing isolated oil houses for the storage of kerosene, etc. During the fiscal year oil houses were completed at Point Judith, N. Y., for \$521.48, and at Carysfort Reef, Fla., for \$188.

#### THIRD DISTRICT.

*Staten Island Lighthouse Depot, N. Y.*—The act of August 1, 1914, appropriated \$23,000 for the erection of a new carpenter shop at the general lighthouse depot, Tompkinsville, N. Y. The work was started in August, 1915, and completed in January, 1916. The structure is a three-story reinforced-concrete building 121 feet by 60 feet. Amount expended to June 30, 1917, \$21,855.49.

#### SIXTH DISTRICT.

*Depot for the sixth lighthouse district.*—The act of October 22, 1913, appropriated \$125,000 for the purchase of a site and the construction of a wharf and buildings for a depot in the sixth lighthouse district. A creosoted-timber wharf and an untreated-timber bulkhead have been constructed. Obsolete buildings have been removed and deposited as riprap around the outside of the bulkhead. The depot site has been filled by hydraulic dredging and fenced in. One of the buildings purchased with the site has been remodeled and since August 1, 1916, has been occupied as the depot storehouse. Amount expended to June 30, 1917, \$125,000.

#### SEVENTH DISTRICT.

*Dry Tortugas Light Station, Fla.*—The act of September 8, 1916, appropriated \$125,000 for repairing and rebuilding aids to navigation, Gulf of Mexico, from which an allotment of \$2,800 was made for this station. During the year a wrought-iron pile wharf with cast-iron caps and wooden girders, stringers, and decking was erected in place of the old wharf, which was destroyed. All work was completed in May, 1917. Amount expended to June 30, 1917, \$2,631.19.

#### TWELFTH DISTRICT.

*Manistique, Mich.*—The act of October 27, 1913, appropriated \$20,000 for aids to navigation, Manistique, Mich. Site was purchased, and a duplex dwelling for two keepers was built. A fixed white post lantern on the west pierhead and a steel tower on a concrete base on the west breakwater, showing an acetylene light, were placed in commission October 30, 1914. A steel tower was erected on a concrete base on the east breakwater and provided with an electric incandescent lamp and a diaphone fog signal, which went into commission August 17, 1916. Amount expended to June 30, 1917, \$19,977.70.



## SIXTEENTH DISTRICT.

*Cape St. Elias Light and Fog Signal Station, Alaska.*—The act of October 22, 1913, appropriated \$115,000 for the construction of a light and fog-signal station at Cape St. Elias, Alaska. A site was selected on the south end of Kayak Island, and construction begun June 1, 1915. Operations were suspended October 7, 1915, for the winter and resumed April 17, 1916. Construction work was suspended October 1, 1916, the station being practically completed. The light was placed in commission September 6, 1916, and the fog signal on January 30, 1917. A radio station was in operation from May 10 to November 9, 1916, to facilitate supervision and expedite construction. A small party, operating in June, 1917, removed construction buildings, cleared premises, etc., and completed station on June 30. Amount expended to June 30, 1917, \$113,545.10.

## SPECIAL WORKS OF CONSTRUCTION UNCOMPLETED (OMITTING VESSELS).

## FIRST DISTRICT.

*Dog Island, Eastport, Me.*—An appropriation of \$3,500 was made by the act of July 1, 1916, for placing an unattended light on Dog Island, Eastport, Me. Immediate steps were taken to procure title to the site, and after considerable delay the matter was placed in the hands of the proper United States district attorney for condemnation proceedings. The date of completion is indefinite. No expenditures were made to June 30, 1917.

## SECOND DISTRICT.

*Cape Cod Canal Lights, Mass.*—The act of August 1, 1914, appropriated \$50,000 for lighting approaches to Cape Cod Canal, Mass. At the eastern entrance, Sandwich, Cape Cod Bay, 1 acetylene high-power gas and bell buoy, 1 Pintach-gas and bell buoy, 1 spar buoy, 1 electric-lighted lens lantern on iron tower on breakwater, and at the western entrance, Buzzards Bay, 3 acetylene-gas and bell buoys, 3 acetylene-gas buoys, 14 acetylene-lighted beacons, 1 first-class can, 1 first-class nun, and 6 spar buoys were established. Upon completion of breakwater at eastern entrance the light will be moved to the end of the same and electrically operated fog bell installed. The candlepower of Wings Neck Light was increased from 180 to 2,900 by installation of oil-vapor apparatus. Internal-combustion engines and compressors have been purchased, and a reed horn will be installed at Wings Neck in place of bell operated by clockwork, about September 1, 1917, completing operations under this appropriation. Amount expended to June 30, 1917, \$47,721.06.

*Woods Hole, Mass., Lighthouse Depot.*—The act of July 1, 1916, appropriated \$50,000 for improvements at Woods Hole (Mass.) depot. The channel leading to the depot, about 3,200 feet long, was dredged to a depth of 17 feet and width of 150 feet; the basin, about 550 feet by 400 feet, was dredged to the same depth, at a cost of \$33,171.79.

Contract has been let in the sum of \$15,377.19, and work is about 35 per cent completed, on construction of a new brick storehouse, 35 feet by 80 feet, two stories high. Amount expended to June 30, 1917, \$33,171.69.

## THIRD DISTRICT.

*Hunts Point, N. Y.*—The act of March 4, 1911, appropriated \$5,000 for establishment of a light and fog signal to mark Hunts Point, between Hell Gate and White-stone Point, East River, N. Y. The work of erecting a structure for the light and fog signal was started in November, 1916, and the light went into commission January 4, 1917. The structure consists of a steel tower built on a stone and concrete foundation, with the necessary provision made for the establishment of a fog signal later when it is practicable to procure electric current for its operation. The date of completion of this project is indefinite. Amount expended to June 30, 1917, was \$3,520.21.

*Aids to navigation, Hudson River, N. Y.*—The act of July 1, 1916, appropriated \$100,000 for improving the aids to navigation and establishing new aids on the Hudson River, N. Y. The work of improving, rebuilding, and establishing will affect 24 different lights. The work in progress consists in building and equipping barge for the purpose, building four steel towers, and action started to purchase necessary land for sites for new lights. The work was started in December, 1916, and it is expected will be completed about October, 1918. The total amount expended to June 30, 1917, was \$40.66.

*Staten Island Lighthouse Depot, N. Y.*—The act of June 12, 1917, appropriated \$21,000 for improving the offices and laboratory at the general lighthouse depot,

Tompkinsville, N. Y. No work has as yet been done or expenditures made under this appropriation.

*Aids to navigation, East River, N. Y.*—The act of June 12, 1917, appropriated \$16,000 for improving the aids to navigation on the East River, N. Y., consisting of improvements and changes in system of lights and the establishment of an additional light. No work has as yet been done or expenditures made under this appropriation.

*Great Salt Pond Light Station, R. I.*—The act of June 12, 1917, appropriated \$20,000 for building new dwelling and moving the fog signal from the inner to the outer end of the breakwater. No work has as yet been done or expenditures made under this appropriation.

#### FOURTH DISTRICT.

*Joe Flogger Shoal, Del.*—The act of June 20, 1906, authorized \$75,000 for establishing a light and fog signal at or near this shoal. The act of June 30, 1906, appropriated \$40,000 for this purpose, and the act of June 17, 1910, increased the limit of cost for this light and fog signal to \$105,000. An additional appropriation has not yet been made. Work on this project has been deferred, as the total amount necessary has not been appropriated and other projects are considered of greater importance. The shoal is now marked by two gas buoys. Amount expended to June 30, 1917, \$603.21.

*Delaware River, Pa. and Del., aids to navigation.*—The act of March 3, 1915, authorized this work. The act of July 1, 1916, appropriated \$80,000 for the purpose. Under this appropriation the following work was performed or under way at the close of the fiscal year. Design and specifications approved for erecting two ranges to mark the new 35-foot channel as follows:

Chester Range Front: Contract awarded; some piles were driven; and riprap deposited for the foundation of the crib.

Chester Range Rear: Contract awarded; foundation piles driven; grillage installed; and concrete piers for tower built.

Marcus Hook Range Front: Contract awarded; materials being collected; and erection will begin in July.

Marcus Hook Range Rear: Design of tower and dwelling completed. A site is being acquired by condemnation proceedings. As soon as it is acquired bids will be invited to erect the tower, etc.

Under this appropriation the bell for Fort Mifflin fog signal was replaced by an electric siren.

It is expected that all work under the appropriation will be completed during 1918. Amount expended to June 30, 1917, \$14,599.06.

#### FIFTH DISTRICT.

*Aids to navigation, Cape Charles City, Va.*—The act of June 12, 1917, appropriated \$12,800 for improving lights and fog signals leading to Cape Charles City, Va. As this appropriation has just been made, nothing definite has been done except to give some preliminary consideration to plans for the main structure to replace Cherry-stone Light Station.

*Aids to navigation, Chesapeake Bay, Md. and Va.*—The act of June 12, 1917, appropriated \$29,000 for aids to navigation on the eastern shore of the Chesapeake Bay and tributaries. As this appropriation has just been made, only preliminary consideration has been given to location of some of the aids to be established.

#### SIXTH DISTRICT.

*St. Johns River, Fla.*—The act of July 1, 1916, appropriated \$66,000 for improving aids to navigation and establishing new aids on the St. Johns River, Fla. Range lens lantern and other illuminating apparatus to the amount of \$4,540, have been purchased and delivered. Six 30-foot rear-range pipe towers and 11 8-foot front-range pipe towers were contracted for and delivered on March 7, 1917. Preparations have been made to construct Wilson Channel Beacons Nos. 1, 3, and 5. A contract to construct one 60-foot pipe tower for Steep Bank Range Rear Light was made April 23, 1917, for the sum of \$1,036.20.

Requisition for 3 type L gas buoys, 3 first-class nuns, 2 first-class cans, and 3 second-class cans has been made, and partial delivery completed. Amount expended to June 30, 1917, \$12,406.50.

#### SEVENTH DISTRICT.

*Florida Reefs, Fla.*—The act of July 1, 1916, appropriated \$75,000 for establishing additional lighted aids and repairing and improving existing aids. Under this appropriation part of the illuminating apparatus was ordered, a portion of which has

been delivered. Plans and specifications for metal work and glass, complete, for two 45-foot light towers, one for Molasses Reef and the other for Pacific Reef, were approved during the year, and advertisement for bids for same, to be opened July 31, 1917, has been issued. The date of completion is indefinite. Amount expended to June 30, 1917, \$1,127.

#### EIGHTH DISTRICT.

*Aids to navigation, Mississippi River, La.*—The act of July 1, 1916, appropriated \$50,000 for the improvement of aids to navigation on the Mississippi River below New Orleans. During the fiscal year a contract, in the sum of \$18,087.50, was awarded to the Union Steel Products Co., of Albion, Mich., for furnishing 25 structural-steel towers. No further progress can be made until these towers are received. Amount expended to June 30, 1917, \$567.57.

*Aids to navigation, Atchafalaya Entrance Channel, La.*—The act of October 22, 1913, appropriated \$50,000 for establishing aids to navigation in Atchafalaya Entrance Channel, La. During the preceding fiscal year, which ended June 30, 1916, Point au Fer Reef Lighthouse and Atchafalaya Entrance Channel Lights Nos. 1, 3, 5, 7, 9, and 2 were completed. Requisition has been made for the necessary gas-lighted buoys, and an order has been placed with the United States naval station, New Orleans, La., for the construction of a 42-foot motor launch. The buoys have not yet been received and the launch has not been completed. Amount expended to June 30, 1917, \$32,708.59.

*Galveston Jetty Light Station, Tex.*—The act of June 11, 1896, appropriated \$35,000 and the act of May 27, 1908, \$10,000 for establishing a light and fog-signal station at or near the outer end of one of the jetties at Galveston Harbor, Tex. Great damage was done the uncompleted structure by the hurricane of August 16-17, 1915, which destroyed the construction wharf, bent the framework of the structure, and washed away much material. Subsequently materials were again assembled, another construction wharf erected, and the framework straightened. The construction wharf was again washed away in the hurricane of August 18, 1916, and some of the lower struts of the substructure were again bent. A portion of the lens for this station was lost in the hurricane of July 5-6, 1916, one box containing parts of same having been washed away from the Mobile Lighthouse Depot. It was ordered replaced from the third district. Intermediate beams to reinforce struts of lower and middle sections were ordered. In March, 1917, the construction wharf was rebuilt for the third time. At the end of May, 1917, the installation of intermediate beams to reinforce struts was completed and the building of a concrete block 49-foot square and in places 10 to 15 feet in depth on northerly and southerly edges was commenced. Amount expended to June 30, 1917, \$44,460.60.

*Repairing and rebuilding aids to navigation, Gulf of Mexico.*—The act of February 28, 1916, appropriated \$200,000 for repairing and rebuilding aids to navigation damaged or destroyed by hurricanes on the Gulf of Mexico. There is given below a list of the work that has been completed and that is in progress, in addition to which there is certain work that has not yet been reached, every effort having been made to restore aids to navigation before less important work was commenced. During the fiscal year the following portions of the work have been completed:

Bayou Dupre Light, La.: Pyramidal structure on four iron-cased creosoted piles, showing oil lens-lantern light, rebuilt.

Biloxi Harbor Lights, Miss.: Repaired and rebuilt 850 feet of wharf, boathouse, etc.

Boats: Five 20-foot power dories and three 16-foot and three 14-foot yawls were built.

Bolivar Roads Day Beacon, Tex.: Pyramidal structure on nine iron-cased creosoted piles rebuilt.

Brazos River Light Station, Tex.: Rebuilt T wharf, walks, storehouse, outhouses, stairways, fences, etc.

Double Bayou Lights Nos. 2 and 4, Tex.: Rebuilt pyramidal superstructure and general repairs.

East Bank Light, Tex.: Pyramidal structure on four iron-cased creosoted piles, showing flashing acetylene light, rebuilt.

Galveston North Jetty Light, Tex.: Increased the height of four iron-pipe piles filled with reinforced concrete, which are embedded in a concrete block; installed tie-rods; rebuilt superstructure; and installed 375-millimeter flashing acetylene light.

Gulfport Channel Lights Nos. 2, 4, and 10, Miss.: Three pyramidal structures, each on nine iron-cased creosoted piles, showing oil lens-lantern lights, rebuilt.

Hitchcock Reef Light, Tex.: Pyramidal structure on four iron-cased creosoted piles, showing flashing acetylene light, rebuilt.

Houston Channel Range Lights, Tex.: Two pyramidal structures, each on nine iron-cased creosoted piles, showing fixed acetylene lights, rebuilt.

Houston Channel Lights Nos. 1, 3, and 3A, Tex.: Three pyramidal structures, each on nine iron-cased creosoted piles, showing flashing acetylene lights, rebuilt.

Houston Channel Lights Nos. 2 and 2A, Tex.: Two pyramidal structures, each on four iron-cased creosoted piles, showing flashing acetylene lights, rebuilt.

Long Point Light, La.: Pyramidal structure on four iron-cased creosoted piles, showing oil lens-lantern light, rebuilt.

New Canal Light Station, La.: Built 400 feet of interlocking creosoted sheet-pile bulkhead and placed reinforced-concrete foundation pillars under storehouse.

Pass Manchac East Channel Light, La.: Pyramidal structure on four iron-cased creosoted piles, showing oil lens-lantern light, rebuilt.

Pearl River Light and Beacon B, La.: Pyramidal structure on four iron-cased creosoted piles, showing oil lens-lantern light, rebuilt; also single iron-cased creosoted pile day beacon.

Port Arthur Canal Light, Tex.: Flashing acetylene light installed on this structure.

Port Bolivar Range Rear Light, Tex.: Pyramidal structure on nine iron-cased creosoted piles, showing oil lens-lantern light, rebuilt.

Sabine Pass East Jetty Light, La.: Built structure consisting of four iron-pipe piles filled with reinforced concrete, embedded in concrete block, braced with tie-rods, supporting pyramidal superstructure, showing 375-millimeter flashing acetylene light.

Sabine Pass Channel Light, La.: Pyramidal structure on nine iron-cased creosoted piles, showing flashing acetylene light.

Sabine Pass Entrance Range and Sabine Pass Inner Range Lights, La.: Four pyramidal structures, each on nine iron-cased creosoted piles, showing oil lens-lantern lights, rebuilt.

Sabine Pass Light Station, La.: Built a 100-foot T-head wharf, 1,500 feet of walk, using creosoted piles and stringers and untreated decking and joists; also new boat-house on six iron-cased creosoted piles.

St. Joseph Island Beacon, La.: Pyramidal structure on four iron-cased creosoted piles rebuilt.

Seabrook, Light, Tex.: Pyramidal superstructure rebuilt and flashing acetylene light installed.

Second Turn Light, Tex.: Pyramidal structure on nine iron-cased creosote piles, showing flashing acetylene light, rebuilt.

Southwest Pass Range Rear Light Station, La.: Built 1,420 feet of walks with T-head, using creosoted piles and stringers and untreated decking.

Tangipahoa River Light, La.: Pyramidal superstructure rebuilt and oil lens-lantern light installed.

Timbalier Lighthouse, La.: Built a new frame structure surmounted by tower and lantern, supported on 25 iron-cased creosoted piles, and established bell for fog signal struck by machinery.

Trinity River Lights A and B, Tex.: Two pyramidal structures, each on four iron-cased creosoted piles, showing oil lens-lantern lights, rebuilt.

West Rigolets Light, La.: Raised this lighthouse 6 feet, and built reinforced-concrete column foundation; repaired outbuildings, walks, wharf, and bulkhead.

The following work is in progress at the end of the fiscal year:

Bolivar Point Light Station, Tex.: Building two frame dwellings supported on high iron columns which rest on pile foundations, oil house, outhouses, and fences.

Chefuncte River Light Station, La.: Materials have been assembled to rebuild breakwater and repair wharf.

Lake Borgne Light Station, Miss.: Materials have been assembled to rebuild boat-house, wharf, walks, steps, platform, etc.

Pointe Aux Herbes Light Station, La.: Rebuilding 510 feet of breakwater with cypress piles and sheet piling.

Sabine Bank Light Station, Tex.: Contract was entered into for furnishing cast-iron work with which to close in veranda floor of lighthouse, renew railings, new davits, and other repairs. The ironwork has not been received at the end of the fiscal year. Amount expended to June 30, 1917, \$113,176.06.

The act of September 8, 1916, appropriated \$125,000 for repairing and rebuilding aids to navigation damaged or destroyed by hurricanes on the Gulf of Mexico, of which \$122,200 was allotted for this district. There is given below a list of the work that has been completed and that is in progress, in addition to which there is certain work that has not yet been reached, and every effort is being made to rebuild aids to navigation before less important work is commenced. During the fiscal year the following work has been completed.

Boat: One 14-foot centerboard yawl was built.

*Pass aux Herons Lights Nos. 2, 4, 6, and 8 and Beacon 2, Ala.:* Four pyramidal structures, each on four iron-cased creosoted piles, showing oil lens-lantern lights, rebuilt and one single iron-cased creosoted-pile day beacon.

The following work is in progress at the end of the fiscal year, a portion of it being completed:

*Mobile Channel Lights, Ala.:* Thirteen structures are being rebuilt, each on nine iron-cased creosoted piles, supporting house surmounted by pyramid, from which light is shown, and one single iron-cased creosoted-pile day beacon. Eight structures which were not destroyed in the hurricane are being repaired. Six lights have been completed, and the foundations have been driven for all new lights.

*Mobile Point Beacon Light, Ala.:* Rebuilding as a pyramidal structure on square creosoted foundation resting on creosoted mudsills supported by creosoted piles.

*Sand Island Light Station, Ala.:* Contract was entered into during the fiscal year for furnishing and placing in position around light tower 2,700 tons of rock, ranging in weight from 1 to 4 tons each piece. The contractor had at the end of the fiscal year landed at the station about 1,400 tons of rock and was placing same in the proper locations as directed. Eight iron-cased creosoted piles have been driven for a new boathouse at this station.

Materials have been assembled with which to rebuild eight lights, in addition to those mentioned above, each to consist of iron-cased creosoted piles supporting pyramidal superstructure. Amount expended to June 30, 1917, \$33,024.24.

*Sabine Jetty Light Station, La.*—The act of May 27, 1908, appropriated \$40,000 for a light and fog signal at or near the end of Sabine Pass Jetty. Nothing has been done on the work, in view of the proposed project of the War Department to extend the jetties to the 25-foot contour, a distance of possibly 2 miles. At the close of the fiscal year 1917 no money had been expended or obligated.

#### NINTH DISTRICT.

*Navassa Island Light Station, West Indies.*—The act of October 22, 1913, appropriated \$125,000 for the erection of a light station on this island. Surveys were made and preliminary plans submitted, which were worked up into final designs in the Bureau's office. The work was advertised in July, 1915, and bids opened September 30, 1915. Contracts were awarded on October 2, 1915, for the metal work and for the erection. The contractors for erecting assembled material, engaged a schooner, and commenced operations at the site in January, 1916. During the spring of 1916 the metal work was completed and shipped, and preparatory work of building camps and construction plant at the island completed. Excavation for the foundation was commenced in May, 1916, and concrete work started shortly after the close of the fiscal year. During the past year the work has progressed steadily, notwithstanding the difficulties presented by the remoteness of the site and the lack of local water supply. The tower, keepers' dwelling, landing facilities, installation of illuminating apparatus, etc., are practically completed, with some work remaining to be done on the railroad track. The light was placed in commission on October 21, 1917. It is expected that the entire project will be completed early in November, 1917. Amount expended to June 30, 1917, \$68,695.79.

#### TENTH DISTRICT.

*Ashtabula Harbor, Ohio.*—The act of October 22, 1913, appropriated \$45,000 for rearranging, rebuilding, and improvement of aids to navigation at Ashtabula Harbor, Ohio. Work has been in progress at the site throughout the year. New light placed in commission September 21, 1916, and new fog signal in commission March 26, 1917. It is expected to complete interior finish of structure during present season. Amount expended to June 30, 1917, \$41,313.45.

*Cleveland Harbor, Ohio.*—The act of October 22, 1913, appropriated \$17,600 for removal, reconstruction, and improvement of the fog-signal station at Cleveland Harbor, Ohio. Fog-signal plant installed and signal in commission August 18, 1916. It is expected to complete interior finish of structure during present season. Amount expended to June 30, 1917, \$17,310.97.

*Lorain Harbor, Ohio.*—The act of October 22, 1913, appropriated \$35,000 for a light and fog-signal station and improvement of aids to navigation at Lorain Harbor, Ohio. On June 30, 1917, the concrete structure had been erected, roof completed except shingling, metal work of lantern erected, and concrete forms removed. Temporary light in commission shown from new lantern. It is expected to install permanent light this season and place fog signal in commission early next season. Amount expended to June 30, 1917, \$31,546.13.

*Conneaut Harbor, Ohio.*—The act of July 1, 1916, appropriated \$63,500 for a light and fog signal and improving aids to navigation at Conneaut Harbor, Ohio. Preliminary plans for the structure have been approved. Contract for steel framework,

railings, and davits for foundation base has been awarded. The structure will probably be completed next season. Amount expended to June 30, 1917, \$704.43.

*Toledo Harbor, Ohio.*—The act of July 1, 1916, appropriated \$15,000 for improving the aids to navigation in Toledo Harbor, Ohio. Contract has been executed for furnishing two skeleton steel towers for Manhattan Range Lights, and it is expected to erect the towers during the present season. Amount expended to June 30, 1917, \$143.00.

*Fairport Harbor, Ohio.*—The act of June 12, 1917, appropriated \$42,000 for improving aids to navigation at Fairport Harbor, Ohio. No expenditures have been made from this appropriation.

*Huron Harbor, Ohio.*—The act of June 12, 1917, appropriated \$4,500 for establishing aids to navigation at Huron Harbor, Ohio. No expenditures have been made from this appropriation.

#### ELEVENTH DISTRICT.

*Detroit River, Mich.*—The act of March 4, 1911, appropriated \$210,000 for establishing aids to navigation along the Livingstone Channel, Detroit River, Mich., including authority to locate and construct lights and to place buoys necessary to properly mark this channel. On June 30, 1917, 12 concrete piers had been completed and 9 beacons lights placed in commission. The other 3 await completion of contemplated changes in the channel before they can be utilized. Thirteen gas buoys and 21 spar buoys are now used to mark the channel, in addition to the lights on piers. Plans have been prepared for the construction of a light and fog signal near the southern end of the channel, which, if carried out, will relieve a lightship now maintained in the locality and which is becoming badly deteriorated, requiring early condemnation. Two additional piers lights will be established, taking the place of gas buoys now maintained on the west side. This can not be done until the proposed channel widening has been completed. In addition to the lights along the channel proper, a semaphore system for controlling the movements of vessels through the channel has been constructed and placed in operation. After one season's operation the continuance of this system was found justified, and steps are now being taken to relocate the semaphore stations in more favorable locations and provide a permanent foundation and structure for the north one. It is expected that the changes in location will be made effective about September 30, 1917. Amount expended to June 30, 1917, \$145,133.99.

*Aids to navigation, Fighting Island Channel, Detroit River, Mich.*—The act of July 1, 1916, appropriated \$25,000 for aids to navigation, Fighting Island Channel, Detroit River, Mich. Under this appropriation, a nonattended flashing acetylene light, known as Fighting Island South, has been established off the south end of the island on a skeleton steel tower to mark the junction of the Fighting Island and Ballard's Reef Channel. Six type S acetylene-gas buoys have been contracted for to mark points along the channel banks, and the construction of a permanent pier light to mark the upper end of the channel on the east side has been started. Fighting Island South Light was placed in commission November 1, 1916, and Pintsch-gas buoys were temporarily established at the opening of navigation this season to mark the locations selected for the permanent acetylene-gas buoys. Three ranges along the channel not adapted to use in the new channel have been discontinued, one light being retained as a side light in each case. It is expected that all work under this appropriation will be completed within the fiscal year 1918. Amount expended to June 30, 1917, \$8,399.25.

*Sand Hills Light Station, Mich.*—The act of June 12, 1917, appropriated \$70,000 for the establishment of a light station and fog signal at or near Sand Hills. The site has been selected and a survey made, also preliminary steps toward purchase have been taken. General plans for the principal structure have been prepared and approved. Detail plans will be prepared and the work commenced this season. Work done this season will probably be limited to clearing, preparation of foundation, construction of workmen's quarters, etc. It is expected that the station will be completed and placed in operation during the season of 1918. No expenditures have been made from this appropriation.

*Aids to navigation, Keweenaw Waterway, Mich.*—The act of June 12, 1917, appropriated \$100,000 for aids to navigation, Keweenaw Waterway, Mich. An examination of the site for the fog-signal and light structure proposed to mark the south entrance to Keweenaw Waterway has been made and a test pile driven to determine bearing power. Plans for the proposed structures are now in the course of preparation. It is expected that the station will be completed and placed in operation during the season of 1918. The construction of a derrick scow to facilitate the work of erection has been commenced. No expenditures have been made from this appropriation.

## TWELFTH DISTRICT.

*White Shoal, Mich.*—The act of March 4, 1907, appropriated \$250,000 for a light and fog-signal station at White Shoal, north end of Lake Michigan, to replace the White Shoal Light Vessel. Tower was completed and light placed in commission September 1, 1910; fog signal placed in commission September 15, 1910; submarine bell established September 20, 1911; water-supply system installed October, 1911; oil-storage system installed June, 1913; auxiliary flashing winter light established December, 1914. Equipment of three boat cranes with air-driven hoists under way. Amount expended to June 30, 1917, \$225,181.57.

*Chicago Harbor, Ill.*—The act of June 12, 1917, appropriated \$88,000 for the removal of Chicago Harbor light and fog signal from its present location to the south end of the north arm of the extension of the exterior breakwater and rebuilding the station. Skeleton steel towers are to be erected on both the north and the south ends of the south-arm extension and are to be equipped with acetylene lights. Plans for the rebuilding of the main light and the foundations and towers for the south arm are being prepared. No expenditures have been made from this appropriation.

*Indiana Harbor, Ind.*—The act of June 12, 1917, appropriated \$100,000 for the establishment and improvement of aids to navigation at Indiana Harbor, Ind. Lighthouse tower and fog signal to be erected at the east end of the north arm of the breakwater. A skeleton steel tower is to be erected on the north end of the south arm on a concrete base and acetylene light installed. No expenditures have been made from this appropriation.

*Manitowoc Breakwater, Wis.*—The act of June 12, 1917, appropriated \$21,000 for improving the light and fog-signal station at Manitowoc, Wis. New steel fog-signal and light station to be erected; improved light to be established; first-class air siren and compressors to be installed. No expenditures have been made from this appropriation.

## SIXTEENTH DISTRICT.

*Aids to navigation, Alaska.*—The acts of August 1, 1914, and June 12, 1917, each appropriated \$60,000 for establishing and improving aids to navigation in Alaskan waters. During the year 2 acetylene lights and 6 gas buoys were established from the above appropriation. Order has been placed for the illuminating apparatus required for 14 additional acetylene lights, and these aids will be established as soon as practicable. On June 30, 1917, the total expenditure from the appropriation of August 1, 1914, was \$58,628.33. No expenditures were made from the appropriation of June 12, 1917, up to June 30, 1917.

## SEVENTEENTH DISTRICT.

*Aids to navigation, Puget Sound, Wash.*—The act of October 22, 1913, appropriated \$30,000 for aids to navigation and improvements in existing aids in Puget Sound and adjacent waters, Washington. Under this appropriation the following work was performed:

West Point Light Station: Three-way horns were installed, and the fog-signal engines and compressors were given a general overhauling, at a cost of \$192.14.

Point Wilson Light Station: A double-mouth horn was installed on siren, at a cost of \$32.

Cape Flattery Light Station: Improvements to fog signal. A diaphone was purchased, at a cost of \$1,320.

Slip Point Light Station: New illuminating apparatus, consisting of a fourth-order bivalve lens with fourth-order vapor lamp, characteristic of light a white flash of 80,000 candlepower every 5 seconds, was installed in place of the former lens lantern, and a new fog-signal plant, consisting of a diaphone and 12-horsepower internal-combustion engines, was established, at a total cost of \$9,204.58.

Lake Washington Canal electric incandescent post lights: Two sets of duplex occulting apparatus, with double lens-lantern lenses, were purchased and turned over to the United States engineers for installation and operation. Cost, \$260.86.

Pully Point electric incandescent post light: The characteristic of this light was changed, and its intensity increased by changing from oil to electricity, at a cost of \$1,043.40.

Apple Cove Point Light: Expended on this project to date, \$1,034.12.

Marrowstone Point Light Station: Change in light and fog signal and erection of new fog-signal building. Cost, \$713.70.

Total amount expended from this appropriation to June 30, 1917, \$25,945.47.

*Kellett Bluff Light Station, Wash.*—The sundry civil act approved July 1, 1916, appropriated \$40,000 for establishing a light and fog-signal station at or near Kellett Bluff, Henry Island, Wash., or at some point on the west coast of San Juan Island, Wash.

After due consideration, the point known as Lime Kiln on the west coast of San Juan Island was decided upon as the location for this aid, to be known as Lime Kiln Light Station and to consist of a fourth-order flashing light and third-order fog signal. Amount expended to June 30, 1917, \$1,258.34.

*Aids to navigation, Coquille River, Oreg.*—The sundry civil act approved July 1, 1916, appropriated \$6,000 for improvements to aids to navigation at or near the entrance to Coquille River, Oreg. An electric incandescent light in lens lantern and an electrically operated fog-signal plant will be established on the opposite side of the river from the present Coquille River Light Station, including new dwelling and out-buildings. Amount expended to June 30, 1917, \$36.34.

## EIGHTEENTH DISTRICT.

*Point Vincente, Cal.*—The act of July 1, 1916, appropriated \$80,000 for establishing a light and fog-signal station at Point Vincente, Cal. The site is under controversy, and the United States district attorney is preparing data preliminary to entering suit for condemnation of suitable site. Sketch drawings have been approved, detail drawings of keepers' quarters have been prepared, and drawings are being prepared for a reinforced tower and lantern parapet. The lens is being assembled at the general depot. Specifications are being considered for the fog-signal installation. Contracts for construction of building will be entered into, if practicable. The date of completion will depend upon the legal proceedings for settlement of site. Amount expended to June 30, 1917, \$13.50.

## UNEXPENDED BALANCES ON JUNE 30, 1917, FROM APPROPRIATIONS FOR SPECIAL WORKS.

District.	Title of appropriation.	Acts.	Balance.
General.....	Tender for first lighthouse district.....	May 27, 1908; Mar. 4, 1909.....	\$8,379.55
	Light vessels for general service.....	Aug. 24, 1912; Aug. 26, 1912.....	155,991.94
	Lighthouse tender, general service.....	Jan. 25, 1915.....	62,701.16
	Light vessels for general lake service.....	June 12, 1917.....	150,000.00
	Radio installations on lighthouse tenders.....	do.....	60,000.00
	Oil houses for light stations.....	June 25, 1910.....	401.10
1st.....	Dog Island Light, Me.....	July 1, 1916.....	3,500.00
2d.....	Cape Cod Canal Lights, Mass.....	Aug. 1, 1914.....	2,278.94
	Woods Hole Lighthouse Depot, Mass.....	July 1, 1916.....	16,828.31
3d.....	Staten Island and West Bank Light Station, N. Y.....	June 30, 1906; Mar. 4, 1909.....	26,027.36
	Newark Bay Beacon Lights, N. J.....	Mar. 4, 1907; Oct. 22, 1913.....	82.19
	Staten Island Lighthouse Depot, N. Y.....	Aug. 1, 1914; June 12, 1917.....	22,144.51
	Hunts Point Light Station, N. Y.....	Mar. 4, 1911.....	1,479.79
	Aids to navigation, Hudson River, N. Y.....	July 1, 1916.....	99,969.34
	Tender for third lighthouse district.....	June 12, 1917.....	150,000.00
	Aids to navigation, East River, N. Y.....	do.....	16,000.00
	Great Salt Pond Light Station, R. I.....	do.....	20,000.00
4th.....	Joe Flogger Shoal Light Station, Delaware River.....	June 30, 1906.....	39,396.79
	Aids to navigation, Delaware River, Pa. and Del.....	July 1, 1916.....	65,400.94
5th.....	Thimble Shoal Light Station, Va.....	June 25, 1910; Aug. 26, 1912.....	6,446.69
	Lighting Norfolk Harbor, Va.....	Mar. 4, 1911.....	2,121.20
	Cape Charles Light Vessel, Va.....	June 12, 1917.....	130,000.00
	Aids to navigation, Cape Charles City, Va.....	do.....	12,800.00
	Aids to navigation, Chesapeake Bay, Md. and Va.....	do.....	29,000.00
6th.....	Tender for engineer, sixth lighthouse district.....	May 27, 1908.....	3,662.74
	Aids to navigation, St. Johns River, Fla.....	July 1, 1916.....	53,593.50
7th.....	Aids to navigation, Florida Reef, Fla.....	do.....	73,875.00
8th.....	Galveston Jetty Light Station, Tex.....	June 11, 1896; May 27, 1908.....	539.40
	Sabine Pass Jetty Light Station, Tex.....	May 27, 1908.....	40,000.00
	Southwest Pass Light Vessel, Mississippi River.....	Oct. 22, 1913.....	14,832.96
	Aids to navigation, Atchafalaya Entrance Channel, La.....	do.....	17,291.41
	Repairing and rebuilding aids to navigation, Gulf of Mexico.....	Feb. 28, 1916; Sept. 8, 1916.....	176,168.51
	Aids to navigation, Mississippi River, La.....	July 1, 1916.....	49,432.43
	Tender and barge, eighth lighthouse district.....	do.....	19,986.86
9th.....	Navassa Island Light Station, W. I.....	Oct. 22, 1913.....	56,304.21
	Point Borinquen Light Station, P. R.....	June 12, 1917.....	85,000.00
10th.....	Cleveland Fog-signal Station, Ohio.....	Oct. 22, 1913.....	289.08
	Aids to navigation, Ashtabula Harbor, Ohio.....	do.....	3,686.55
	Aids to navigation, Lorain Harbor, Ohio.....	do.....	3,453.87
	Aids to navigation, Conneaut Harbor, Ohio.....	July 1, 1916.....	62,795.57
	Aids to navigation, Toledo Harbor, Ohio.....	do.....	14,857.00
	Aids to navigation, Huron Harbor, Ohio.....	June 12, 1917.....	4,500.00
	Aids to navigation, Fairport Harbor, Ohio.....	do.....	42,000.00
11th.....	Superior Pierhead Range Lights, Wis.....	June 30, 1906.....	3,100.92
	Detroit River Lights, Mich.....	Mar. 4, 1911.....	64,866.01
	Aids to navigation, Ashland, Wis.....	Oct. 22, 1913.....	56.30
	Aids to navigation, Fighting Island, Mich.....	July 1, 1916.....	14,680.75



## UNEXPENDED BALANCES ON JUNE 30, 1917, FROM APPROPRIATIONS FOR SPECIAL WORKS—Continued.

District.	Title of appropriation.	Acts.	Balance.
11th .....	Sand Hills Light Station, Mich.	June 12, 1917.	\$70,000.00
	Aids to navigation, Keweenaw Waterway, Mich.	do.	105,000.00
12th .....	White Shoal Light Station, Lake Michigan.	Mar. 4, 1907.	24,818.43
	Chicago Harbor Light Station, Ill.	June 12, 1917.	88,000.00
	Manitowoc Breakwater Light Station, Wis.	do.	21,000.00
	Aids to navigation, Indiana Harbor, Ind.	do.	100,000.00
16th .....	Aids to navigation, Alaska.	Aug. 1, 1914; June 12, 1917.	61,271.67
	Cape St. Elias Light Station, Alaska.	Oct. 22, 1913.	1,454.90
17th .....	Aids to navigation, Puget Sound, Wash.	do.	4,054.53
	Kellett Bluff Light Station, Wash.	July 1, 1916.	38,741.66
	Aids to navigation, Coquille River, Oreg.	do.	5,963.66
	Aids to navigation, Washington and Oregon.	June 12, 1917.	35,000.00
18th .....	Point Vicente Light Station, Cal.	July 1, 1916.	79,886.50
19th .....	Aids to navigation, Pearl Harbor, Hawaii.	June 12, 1917.	80,000.00

## BALANCES OF SPECIAL APPROPRIATIONS CARRIED TO THE SURPLUS FUND ON JUNE 30, 1917.

The following-named balances of special appropriations under the Lighthouse Service remaining on the books of the Treasury Department and relating to works which had been completed and against which no obligations were known to exist were carried to the surplus fund on June 30, 1917:

Tender for fifteenth lighthouse district.	\$276.72
Rondout Creek Light Station, N. Y.	6,424.19
Fort McHenry Channel Range Lights, Md.	295.19
Milwaukee Light Vessel, Wis.	459.73
Aids to navigation, Manistique, Mich.	.04

Total carried to surplus fund. . . . . 7,455.87

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
1st.....	A. J. Clinch, keeper, Franklin Island Light Station, Me.	Motor boat; William Collamore, owner.	Towed disabled boat with occupant to shore.
	J. B. Thurston, keeper, Fort Point Light Station, Me.	Motor boat.	Towed disabled boat, with 8 men on board, to safe anchorage.
	do.	do.	Towed disabled boat, with 1 man aboard, to safe anchorage.
	A. B. Hamor, assistant keeper, Egg Rock Light Station, Me.	Motor boat, Walter Rath in charge.	Towed disabled boat to Bar Harbor, Me.
	Tender Zizania.		Rescued from drowning 2 men fallen overboard from Grand Trunk Wharf, Portland, Me.
	E. H. Pierce, keeper, Doubling Point Range Light Station, Me.		Rescued from drowning insane man who jumped from wharf at Bath, Me.
	Tender Zizania.	Sloop.	Rescued 2 men marooned on Pettis Rock, Kennebec River, Me., and transported them to Bath, Me.
	Tender Hibiscus.	Schooner Mary A. Hall, Capt. George Olsen.	Towed lumber-laden schooner, in dangerous position, to anchorage in Portland Harbor, Me.
	W. P. Kent, keeper, Egg Rock Light Station, Me.	Motor boat.	Towed disabled boat, with 2 fishermen aboard, to station.
	A. C. Holt, keeper, Deer Island Thorofare Light Station, Me.	Schooner Sarah and Lucy, Capt. Perry; steamer Minnehaha.	Assisted in floating schooner, ashore on rocks off Andrews Island, Me., also assisted in towing disabled steamer Minnehaha to place of safety.
	J. E. Purington, keeper, Nash Island Light Station, Me.	Freighter B. B. W.; Jonesport Transportation Co.	Assisted in recovering freight and furnished crew with lodging and meals.
	A. C. Holt, keeper, Deer Island Thorofare Light Station, Me.	Motor boat; Everett Gross, owner.	Towed disabled boat to Stonington, Me.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
1st.....	Portland Light Vessel No. 74, Me..	Motor boat: Charles Burgess, owner.	Furnished boat with batteries, etc.
	.....do.....	Motor boat: George McDonald, owner.	Hoisted boat and furnished wire and tools to tighten propeller.
2d.....	E. C. Mott, keeper, Deer Island Light Station, Mass.	Power boat Marion; Albert Moses, owner.	Towed disabled boat to safe anchorage, repaired engine, and furnished food and dry clothing to 3 occupants.
	Tender Azalea.....	Schooner yacht Hopewell, of Providence, R. I.	Pulled off stranded schooner and towed her to deep water.
	.....do.....	Knockabout Nellie, of Providence, R. I.	Towed disabled boat to Vineyard Haven, Mass.
	Nantucket Shoals Light Vessel No. 85, Mass.	Schooner Victor and Ethan; steamers Strathdene, West Point, and Christiana Knudson.	Furnished food and lodging to 115 shipwrecked men until arrival of United States destroyers.
	Stone Horse Shoal Light Vessel No. 5, Mass.	Fishing schooner Pontiac.	Furnished lodging to captain and 16 men of grounded vessel.
	T. Poole, laborer, Lovells Island Depot, Mass.	.....	Rescued from drowning boy fallen off wharf.
	H. L. Thomas, keeper, Nantucket (Great Point) Light Station, Mass.	Schooner Roger Drury, of Boston, Mass.	Furnished food and dry clothing to captain and 5 men who abandoned sinking vessel.
	L. B. Clark, keeper, Cuttyhunk Light Station, Mass.....	Power boat Champion, of Newport, R. I.	Assisted in landing boat, with 2 men aboard, driven ashore by gale.
	Tender Azalea.....	Dory.....	Towed to pier dory, with 3 men aboard, caught in ice jam.
	H. L. Thomas, keeper, Nantucket (Great Point) Light Station, Mass. C. Stoll, assistant keeper, Nantucket (Great Point) Light Station.	Steamer A. T. Serrell, of Newport, R. I.	Assisted ashore crew of 8 men of disabled vessel caught in ice pack, and quartered crew at light station until arrival of Coast Guard.
	G. Bartlett, first officer, tender Azalea.	.....	Rescued man from overturned dory and placed him aboard barge.
	Great Round Shoal Light Vessel No. 86, Mass.	Dory from schooner W. H. Moody, of Gloucester, Mass.	Rescued 2 men in exhausted condition, adrift in blizzard 30 hours, and furnished them food and lodging.
	G. A. Faulkner, keeper, Palmer Island Light Station, Mass.	.....	Rescued from drowning 2 men from overturned skiff and cared for them until arrival of harbor police.
	Boston Light Vessel No. 54, Mass..	Motor boat.....	Rescued from drowning 3 fishermen in motor boat and furnished them food and lodging.
	A. A. Howard keeper Ipswich Range Light Station, Mass.	Schooner George M. Warner, of Yarmouth, N. S.	Furnished food, dry clothing, and lodging to captain and crew.
3d.....	Tender Pansy.....	Portland packet.....	Rescued captain and 3 men in exhausted condition in small boat from abandoned vessel grounded on Romer Shoal and recovered vessel.
	.....do.....	Motor boat, of Poughkeepsie, N. Y.	Recovered disabled motor boat with three boys aboard and towed her to dock.
	J. F. Woods, keeper, Saybrook Breakwater Light Station, Conn.	Speed boat.....	Towed disabled speed boat, with two occupants aboard, to station.
	.....do.....	Schooner Silver Queen.	Rendered aid to captain with crushed hand and cared for him until arrival of doctor.
	K. Hanson, keeper; J. J. Price, first assistant keeper; and S. C. Wright, second assistant keeper, Absecon Light Station, N. J.	Yacht Cerenty.....	Assisted in getting distressed yacht off bar.
	J. H. Woods, keeper, Saybrook Breakwater Light Station, Conn.	Sloop Jolly Tar.....	Pulled sloop off shore on west side of breakwater with power boat.
	W. M. Chapel, keeper, Plum Island Light Station, N. Y.	Tug S. L. Hommedieu.	Rescued captain and wife, adrift, from sinking tug, in open boat, without oars.
	E. E. Gildersleeve, keeper, Saybrook Point Light Station, Conn.	.....	Extinguished fire in cottage.
	J. A. Miller, keeper, Bridgeport Harbor Light Station, Conn.	Sloop Samuel C. Bond.	Assisted in getting sloop off breakwater.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
3d.....	Tender Pansy.....	Yacht Trio; John Pierson, owner.	Towed yacht, in sinking condition, with two occupants aboard, to yacht basin, South Brooklyn, N. Y.
	E. M. Grant, keeper, Stepping Stones Light Station, N. Y.	Yacht Damascara; David M. Myers, owner.	Rescued owner and guest from disabled yacht and furnished them meal.
	S. Dodge, keeper, W. H. Clark, first assistant keeper, Block Island (southeast) Light Station, R. I.	U. S. Army hydroplane.	Assisted in saving damaged hydroplane, which alighted in surf near station, and in repairing same, and furnished occupants lodging and clothing.
	Tender John Rodgers.....	Launch Ellis, U. S. Engineers, New London, Conn.	Assisted in saving launch, near sinking, at Customhouse Wharf.
	W. F. Rhodes, keeper, and F. L. Thompson, assistant keeper, Greens Ledge Light Station, Conn.	Oyster boat.....	Assisted in extinguishing flames.
	Tender Myrtle.....	Motor boat Try On..	Towed disabled motor boat, with two men aboard, to shore.
	W. J. Murray, keeper; S. Kendzia, first assistant keeper; and J. F. Newman, second assistant keeper, Little Gull Island Light Station, N. Y.	Auxiliary sailboat, C. E. Beach, owner.	Towed boat, adrift, to station.
	Cornfield Point Light Vessel No. 48, Conn.	Small power boat...	Towed small power boat, adrift, with 1 occupant, to Saybrook Point.
4th.....	W. H. Schellenger, keeper, and C. H. Hickman, second assistant keeper, Harbor of Refuge Light Station, Del.	Motor boat.....	Recovered disabled motor boat, with 6 men aboard, blown off-shore from light station.
5th.....	W. J. Tate, keeper, North Landing River, Currituck Sound, Coinjock Bay, and North River Aids, N. C.	Launch.....	Rendered assistance to disabled launch.
	Tender Jessamine.....	Schooner Jessie Irving.	Floated schooner ashore on Kent Island Shoal, Md.
	W. J. Tate, keeper, North Landing River, etc., Aids.	Schooner Hobson...	Assisted in floating schooner ashore near station.
.....do.....	.....do.....	Freighter R. C. Beaman.	Rendered assistance to disabled freighter.
.....do.....	.....do.....	Boat Muriel Dean...	Assisted in floating boat.
.....do.....	.....do.....	Launch.....	Assisted in making emergency repairs to launch.
.....do.....	.....do.....	Yacht Idlewell.....	Piloted yacht which had lost her way.
.....do.....	.....do.....	.....do.....	Assisted in repairing disabled aeroplane and provided shelter for occupants.
.....do.....	.....do.....	Motor boat.....	Aided disabled boat and assisted in repairing same.
.....do.....	.....do.....	.....do.....	Towed disabled motor boat to safe harbor.
.....do.....	.....do.....	North Carolina Fisheries Commission boat Gretchen.	Assisted in floating boat and conveyed State fish commissioner to Coinjock, N. C.
	Tender Maple.....	Schooner Rattler, Capt. Frank Gibson.	Towed disabled and sinking schooner to harbor and rescued complement of 4 men.
	J. F. Hudgins, keeper, Neuse River Light Station, etc., N. C.	Launch.....	Rescued 9 persons from disabled launch.
	Tender Maple.....	Steamer Severn and bugeye Mary E. Fouble.	Rendered assistance to steamer and bugeye, which collided.
	W. H. Davis, keeper, Lazaretto Lighthouse Depot, Md.	.....do.....	Went to assistance of those on board these boats.
	C. C. Tyler, keeper, Great Shoals Light Station, Md.	Launch.....	Rendered assistance to 3 persons in disabled launch and furnished them food and shelter.
	Tender Jessamine.....	.....do.....	Rescued man from drowning.
	W. M. Midgett, assistant keeper, Love Point Light Station, Md.	.....do.....	Assisted in rescuing drowning man.
	W. J. Tate, keeper, North Landing River, etc., Aids, N. C.	Yacht.....	Floated stranded yacht.
.....do.....	.....do.....	Yacht Abeela, of New York.	Repaired engine of yacht.
	G. M. Willis, sr., keeper, Cedar Point Light Station, Md.	Launch Jane.....	Floated launch aground on bar near light station and furnished lodging to crew.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
5th.....	Tender Maple.....	Oyster boat Lady Eleanora.	Towed boat, anchored with masts and sails overboard, to Baltimore, Md.
	.....do.....	Schooner S. E. Lankford.	Floated schooner ashore at Mathias Point, Md.
	.....do.....	Bateau Princess.....	Went to assistance of bateau and landed crew at Annapolis, Md.
	.....do.....	Schooner Ada J. Campbell.	Went to assistance of schooner, with decks awash, and towed her to safe anchorage.
	Tender Orchid.....	Tug W. S. Embrey, of New York.	Towed disabled tug, with 5 persons aboard, to safety.
	W. Newton, keeper, Harbor Island Bar Light Station, N. C.	Schooner Lacy.....	Floated and towed schooner to harbor.
	G. G. Johnson, assistant keeper, Old Plantation Flats Light Station, Va.	Motor boat.....	Towed disabled motor boat to station, furnished occupants food, and towed boat to Cape Charles, Va.
	T. D. Quidley, keeper, Neuse River Light Station, etc., N. C.	Freight boat Olive..	Towed heavily laden freight boat to safe harbor.
	H. S. Moore, keeper, Janes Island Light Station, Md.	Skiff.....	Rendered assistance to occupants of skiff caught in ice near station and furnished them food and lodging.
	Tender Laurel.....	Motor boat.....	Towed disabled motor boat, containing 7 persons, to Washington, N. C.
	Tender Holly.....	Schooner Thomas J. Seward.	Pulled schooner ashore on Point Breemo, Va., into deep water.
	T. H. Baum, keeper, Long Shoal Light Station, N. C.	Power boat E. R. Daniels.	Assisted disabled power boat and helped repair engines.
	L. V. Gaskill, assistant keeper, Long Shoal Light Station, N. C.	.....do.....	Do.
	C. A. Sterling, keeper, Craney Island Light Station, Va.	Yacht Joan III, of Norfolk, Va.	Rescued member of crew from drowning and towed yacht to safe harbor.
6th.....	Tender Cypress.....	U. S. S. Hector.....	Rescued master and 20 others left on wrecked steamer.
	.....do.....	British S. S. Oak Branch.	Picked up moorings off Charleston Harbor and delivered them to vessel's agents in Charleston, S. C.
	.....do.....	Motor boat Acme....	Towed disabled boat, with 4 men aboard, to Charleston, S. C.
	Tender Mangrove.....	British S. S. Nevisian.	Assisted in floating vessel grounded on St. Simon Bar, Ga.
	.....do.....	Power boat Kurkimwah; W. G. Hinson, James Island, S. C., owner.	Picked up boat adrift off Fort Sumter and delivered it to Charleston Lighthouse Depot.
	Tender Snowdrop.....	Small boat.....	Rescued party of 11 persons from perilous position in Winyah Bay, S. C., and transferred them to Georgetown, S. C.
	A. F. Wichmann, keeper, Cape Romain Light Station, S. C.	Barge Northwest....	Assisted captain and 4 others washed ashore.
	J. Cromley, keeper, and R. H. Cromley, assistant keeper, Sapelo Light Station, Ga.	Schooner Perry Selzer.	Assisted schooner in distress off Sapelo Light Station and secured tug for tow to Brunswick, Ga.
	L. H. Bringlee, keeper, and J. Grisillo, second assistant keeper, Charleston Light Station, S. C.	Small boat.....	Assisted 2 fishermen in breakers in reaching shore near light station.
	T. Knight, keeper; J. H. Menges, first assistant keeper; and W. E. McCreary, second assistant keeper, Hillsboro Inlet Light Station, Fla.	Motor boat.....	Rescued 3 persons from upset motor boat and furnished them clothing and food.
	T. Knight, keeper, and W. E. McCreary, second assistant keeper, Hillsboro Inlet Light Station, Fla.	Barge Hildegard; Alfred Clement, New Orleans, La., owner.	Telegraphed to Key West, Fla., for aid for grounded vessel.
	B. Heisser, keeper, Jupiter Inlet Light Station, Fla.	S. S. Sangstad, United Fruit Co., Boston, Mass., owners.	Requested aid by wireless for vessel ashore off Jupiter Inlet, Fla.
	F. Traugott, keeper, Hunting Island Light Station, S. C.	Tug Passport; Savannah River Lumber Co., Savannah, Ga., owners.	Advised owners by telegraph of disabled condition of tug near light station.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
7th.....	Tender Snowdrop.....	Greek schooner Maria Louisa.	Rescued 5 members of crew from wreck on Dry Tortugas and transported them to Key West, Fla.
	Tender Ivy.....	.....do.....	Assisted in trying to pull wreck off shoals.
8th.....	M. W. Streckert, keeper, and O. H. Beadnell, second assistant keeper, Sand Island Light Station, Ala.		Maintained light during hurricane.
	M. Brown, first assistant keeper, Sand Island Light Station, Ala.		Saved property during hurricane.
	T. P. Roberts, assistant keeper, Aransas Pass Light Station, Tex.		Maintained light and protected property during hurricane.
	G. R. Smith, keeper, and L. R. Smith, assistant keeper, Red Fish Bar Cut Light Station, Tex.	Schooner Adele.....	Rescued crew of 2 men from foundered vessel and furnished them food and clothing.
	Tender Sunflower.....	S. S. Standard; Standard Oil Co., Bayonne, N. J., owners.	Floated vessel grounded in South Pass, La.
	J. W. Sprinkle, laborer in charge, Pass Aux Herons Lights, Ala.	Launch Bernice, of Point Clear, Ala.	Assisted disabled launch.
	G. R. Smith, keeper, and L. R. Smith, assistant keeper, Red Fish Bar Cut Light Station, Tex.	Launch Emmy.....	Assisted disabled launch and furnished provisions and water to occupants.
	A. Rodt, keeper, South Pass East Jetty Light Station, etc., La.	U. S. torpedo boat Flusser.	Assisted in landing crew of vessel stranded on beach near light station.
	J. H. Portman, keeper, and F. A. Schrieber, assistant keeper, Round Island Light Station, etc., Miss.	Motor boat.....	Assisted occupants of disabled boat and furnished them food and shelter.
	M. W. Streckert, keeper; M. Brown, first assistant keeper; and O. H. Beadnell, second assistant keeper, Sand Island Light Station, Ala.	Launch; Aug. Writz, owner.	Towed disabled launch to place of safety and furnished occupants fuel, food, and shelter.
	F. A. Schrieber, assistant keeper, Round Island Light Station, etc., Miss.	Small sailboat.....	Towed disabled boat to entrance of Pascagoula River.
	G. R. Smith, keeper, Red Fish Bar Cut Light Station, Tex.	Motor tug Fortune..	Rescued crew of 3 men from wreck of motor tug.
10th.....	B. A. Dissett, first assistant keeper, Toledo Harbor Light Station, Ohio.	Launch.....	Towed disabled launch to light station and furnished food to occupants.
	.....do.....	Yacht Dorel.....	Towed sunken yacht to light station and righted and towed her to Toledo, Ohio.
	G. F. Ferguson, keeper, Fort Niagara Light Station, N. Y.		Assisted in rescuing man adrift on the ice on Lake Ontario.
	C. Fitzmorris, keeper, West Sister Island Light Station, Ohio.	Yacht Luella; P. C. and C. A. Peters, owners.	Rescued 6 persons from capsized yacht, assisted in righting yacht, and furnished food and clothing to occupants.
	.....do.....	Launch Baby Rambler.	Furnished shelter and dry clothing to 2 men en route to Toledo, Ohio.
	.....do.....	Launch Exalta.....	Furnished 4 men from disabled launch food and lodging.
	D. D. Hill, keeper, Cross Over Island Light Station, N. Y.	Barge Brighton; Montreal Transportation Co.	Assisted in removing crew and personal effects from barge grounded near station.
	F. Ritter, keeper, Sandusky Bay Inner Range Light Station, Ohio.	Launch.....	Towed launch to safety.
	.....do.....	.....do.....	Towed disabled launch, with 7 persons aboard, to Sandusky, Ohio.
11th.....	A. Shaw, Jr., keeper, Presque Isle Light Station, Pa.		Prevented spreading of fire in vicinity of station.
	W. A. Burke, keeper, Saginaw River Range Light Station, Mich.	Sailboat; Earl Beutel, owner.	Towed disabled boat to safety.
	L. McDonald, first assistant keeper, and E. C. Towns, second assistant keeper, Port Austin Reef Light Station, Mich.; D. McDonald, second assistant keeper, Detroit Light Station, Mich.		Assisted in rescuing 3 fishermen adrift on ice.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
11th.....	L. McDonald, first assistant keeper, and E. C. Towns, second assistant keeper, Port Austin Reef Light Station, Mich.	Gasoline fish boat; I. S. Osborn, owner.	Towed disabled boat to safety.
	H. Koondway, second assistant keeper, Fourteen Mile Point Light Station, Mich.	Motor boat Florence.	Do.
	A. McLean, keeper, and C. G. Wright, second assistant keeper, Huron Island Light Station, Mich.	Launch Petrel.....	Towed disabled motor boat adrift in a heavy sea to safety, and furnished occupants food, lodging, and dry clothing.
	W. G. Marshall, keeper, Windmill Point Light Station, Mich.	.....	Rescued man from drowning.
	F. G. Somner, keeper, Detour Light Station, Mich.	Launch Adolph; Spencer M. Hill, owner.	Towed disabled launch to safety.
	F. Warner, keeper, Birch Point Range Lights, Mich.	Motor boat; R. V. Duncan, owner.	Recovered disabled boat adrift in violent gale.
	N. Ahear, keeper, Frying Pan Island Light Station, Mich.	Tug Rambler.....	Furnished food to passengers of tug caught in ice and brought passengers and mail ashore.
	.....do.....	Motor boat; M. J. Andress, owner.	Towed disabled boat to safety.
	E. C. Byrne, first assistant keeper, Point Iroquois Light Station, Mich.	Motor boat; John Evans, owner.	Towed leaky boat to safety and furnished occupants food and lodging.
	C. T. Davis, keeper, Copper Harbor Range Lights, Mich.	Canoe.....	Furnished food and dry clothing to man from capsized canoe.
12th.....	T. E. Martin, assistant keeper, Michigan City Light Station, Ind.	.....	Rescued from drowning man and boy fallen off pier.
	T. J. Armstrong, keeper, Michigan City Light Station, Ind.	.....	Rescued from drowning boy fallen off pier.
	O. C. McCauley, keeper, and C. Lomms, first assistant keeper, Squaw Island Light Station, Mich.	Launch Phyllis; J. Brown, owner, Scotts Point, Mich.	Towed disabled boat with 2 occupants ashore.
	J. H. Sullivan, second assistant keeper, White Shoal Light Station, Mich.	Motor boat.....	Towed disabled motor boat into harbor.
	E. H. Cornell, keeper, and J. Fitzgerald, assistant keeper, Pottawatomie Light Station, Wis.	Steamer Peter Reiss.	Notified Coast Guard and delivered messages to stranded steamer.
	O. C. McCauley, keeper, Squaw Island Light Station, Mich.	Fish tug Margaret McCann.	Towed disabled boat 5 miles into harbor.
	R. F. Wright, first assistant keeper, Manitowoc Light Station, Wis.	Launch Manowis....	Assisted in releasing launch that had beached.
	J. W. Barrand, mate, and R. Peterson, cook, Eleven Foot Shoal Light Vessel No. 60, Mich.	.....	Rescued from drowning man fallen into water from the ice.
	L. Gronning, laborer, Chicago Pier-head Range Light Station, Ill.	.....	Rescued from drowning man fallen off pier.
	W. Donovan, first assistant keeper, and S. O. Thorrien, laborer, Chicago Harbor Light Station, Ill.	Launch Thetis, City of Chicago.	Pulled stranded launch off breakwater and towed her to light station; notified Coast Guard.
	F. Sheridan, keeper, Chicago Harbor Light Station, Ill.	Launch May.....	Furnished gasoline to launch in danger of drifting on breakwater; towed her to another vessel.
	L. Gronning, laborer, Chicago Pier-head Range Light Station, Ill.	.....	Assisted in rescuing man blown off pier by wind.
	J. K. Robinson, keeper, Calumet Harbor Light Station, Ill.	.....	Rescued woman from drowning.
	J. H. Nelson, first assistant keeper, Calumet Harbor Light Station, Ill.	Motor boat Sea Gull, U. S. Engineer Department.	Assisted in rendering aid to disabled boat.
	E. C. Sterritt, keeper, Twin River Point Light Station, Wis.	Motor boat Ann Ella.	Notified Coast Guard, who rendered assistance to disabled motor boat.
	R. W. Johnson, keeper, and M. Telgard, first assistant keeper, North Manitou Light Station, Mich.	Motor boat Teal; Peter Stormer, owner.	Towed disabled boat, with 3 men aboard, to shore and furnished them gasoline.
16th.....	Tender Fern.....	S. S. Admiral Farragut; Pacific Alaska Navigation Co., E. D. Hickman, master.	Removed passengers and assisted in pulling grounded vessel clear on flood tide.
	D. O. Kinyon, keeper, Guard Island Light Station, Alaska.	Motor boat.....	Towed to station.

## SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
16th.....	R. McKlem, keeper; G. Alexius, first assistant keeper; and J. C. Jespersen, second assistant keeper, Eldred Rock Light Station, Alaska. D. O. Kinyon, keeper, Guard Island Light Station, Alaska. S. G. Olsen, keeper; E. Pecor, first assistant keeper; and W. J. Morgan, second assistant keeper, Cape Hinchinbrook Light Station, Alaska. S. F. Shepard, keeper, Mary Island Light Station, Alaska. Tender Fern.....	Fish-trap watchman, Chilkoot cannery.  Launch Holdahl 2nd ..... Motorboat Retriever; Chas. Baker, owner. Barge Henry Villard; James Griffiths & Sons, owners. Fishing boat Nara...	Conveyed injured man to station and took him to Haines, Alaska, for medical treatment.  Furnished occupants gasoline.  Furnished shelter, clothing, and subsistence to shipwrecked and stormbound native mail carriers.  Furnished gasoline to occupants. Towed barge into Ketchikan, Alaska.
17th.....	Columbia River Light Vessel No. 88, Oreg. J. E. Thomas, keeper, and H. J. Williams, assistant keeper, Ediz Hook Light Station, Wash. L. A. Pettersen, keeper, West Point Light Station, Wash.	Launch.....  Sailboat Mist; George DeBritz, owner.	Rendered assistance to boat containing 2 men. Towed disabled launch, containing 2 men, to safe anchorage.  Towed disabled boat off rocks near station to Ballard, Wash., for repairs.
18th.....	G. A. Cobb, keeper, and T. S. Thomson, assistant keeper, Humboldt Bay Fog Signal Station, Cal.	U. S. submarine H-3	Assisted in rescuing 27 men from vessel ashore.
19th.....	Tender Columbine..... .....do.....	Schooner Muriel.....	Searched for Army launch lost off Oahu Island. Towed grounded schooner, with 2 lighters, to safe anchorage and floated her by lightening cargo.

## DAMAGE BY COLLISIONS.

On November 24, 1916, Pollock Rip Light Vessel No. 47, Mass., was fouled by a barge in tow of the tug *Calvert*. Cost of repairs in the sum of \$494 was paid by the owners of the vessel.

On January 13, 1917, Stone Horse Shoal Light Vessel No. 5, Mass., was fouled by the barge *Belfast* in tow of the tug *William B. Keene*, causing damages to the extent of \$463, which amount was paid by the owners of the tug.

On January 19, 1917, Pollock Rip Light Vessel No. 47, Mass., was fouled by a barge in tow of the tug *Standard*. Cost of repairs in the sum of \$1,204.28 was paid by the owners of the tug.

On January 21, 1917, Handkerchief Light Vessel No. 3, Mass., was fouled by the barge *Nanticoke* in tow of the tug *Tacony*. The owners of the tug have agreed to pay for the damages, estimated at about \$650.

On July 8, 1916, Sheepshead Bay Outer Light was run into by the steamer *Giralda*. Damage to the light in the amount of \$218.61 was paid by the owner of the vessel.

On October 21, 1916, the American S. S. *Moldegaard* collided with and sunk Joe Flogger Shoal Gas and Bell Buoy 11A. Cost of repairs in the sum of \$576.89 was paid by the owners of the vessel.

On October 30, 1916, the British S. S. *Panama Transport* collided with the upstream wharf at Fort Mifflin, Pa., causing damage to lighthouse property to the extent of \$230.28. Steps have been taken to have the damage paid for by the owners of the vessel.

On September 1, 1916, Aaron Shoal Beacon Light, Va., was collided with and completely destroyed by the tugboat *W. W. Graham*. The beacon was rebuilt by the owners of the tug at an estimated cost of \$225.

On November 29, 1916, Brewerton Channel Gas Buoy No. 8B was collided with by the S. S. *Melrose*, causing damage to the buoy in the estimated amount of \$280.40, which was paid by the owners of the vessel.

On December 18, 1916, Cape Charles Light Vessel No. 101, Va., was collided with by the Danish motorship *Oregon*, causing damage to the light vessel in the estimated amount of \$3,500. The cost of repairs have been paid by the owners of the vessel.

On January 6, 1917, Croatan Light Station, N. C., was collided with by the tug *Curtin* with four barges in tow, causing damage to the light station in the estimated amount of \$120, which the owner of the tug has agreed to pay for.

On January 15, 1917, an auto truck used at the Portsmouth Lighthouse Depot, Va., collided with a street car, causing damages to the auto truck to the extent of \$133.60. Steps have been taken to have the damage paid for by the street car company.

On February 7, 1917, Curtis Bay Entrance Buoy 5M was collided with by the S. S. *Sherman*, inflicting damages in the estimated amount of \$185, which the owners of the vessel have agreed to pay.

On October 1, 1916, Charleston Light Vessel No. 34, S. C., was struck by a lighter in tow of the tug *Bee*, causing damages to the light vessel in the amount of \$894.20. The claim was compromised.

On November 21, 1916, Forrester Point Lower Range Front Light No. 62, St. Johns River, Fla., was damaged by the S. S. *Osceola* in the amount of \$100, which was paid by the Government.

On December 26, 1916, Forrester Point Upper Range Front Light No. 66, St. Johns River, Fla., was damaged by the steamer *Clivedon* in the amount of \$100. The claim was compromised.

On April 8, 1917, New Channel Range Front Light, N. C., was damaged by the houseboat *Everglades* in the amount of \$887. Efforts are being made to have the owner of the vessel pay for the damages.

On April 8, 1917, Battery Island Light No. 2A, N. C., was damaged by the houseboat *Everglades*. Efforts are being made to have the owner of the vessel pay for the damages amounting to \$775.

On October 21, 1916, Nashua Light No. 84, Fla., was damaged by a tow of the tug *Resolute*. The light was rebuilt by the Government at a cost of \$100.

On September 12, 1916, Mackey Point Light, Savannah, Ga., was damaged by boat of contractor engaged in dredging Savannah River. The structure was rebuilt by the owners of the boat at a cost of about \$100.

On July 29, 1916, Galveston Bay Channel Range Front Light, Tex., was collided with by a barge in tow of the tug *Wm. J. Kelley*. The cost of repairs, \$171.82, was paid by the owners of the tug.

On June 7, 1917, the tower of Cleveland West Pier Light, Ohio, was destroyed by the steamer *J. C. Morse*, in tow of tugs *Frank W* and *Lorain*. The tower will be replaced by the owners of the tugs at an estimated cost of \$850.

On May 23, 1917, the tender *Crocus* was struck by the steamer *City of Detroit III* in tow of the tugs *Pennsylvania* and *Georgia*, inflicting damages estimated at \$475. The responsible parties authorized the necessary repairs, which have been completed.

On June 5, 1916, Middle Ground Southwest Buoy 9, St. Marys River, Mich., was carried away by the steamer *Moses Taylor*. The owners of the steamer paid the cost of replacing the buoy, \$139.54.

On June 17, 1917, Livingstone Channel Gas Buoy 3B, Detroit River, Mich., was collided with by the tug *Gladiator*, with dredge and scow in tow, inflicting damages to the buoy to the extent of \$279.79, which were paid for by the owners of the tug.

On August 28, 1916, Redwood Creek Beacon No. 1, Cal., was collided with by an unknown vessel. The beacon was replaced at the expense of the Government at a cost of \$148.20.

On September 28, 1916, Deadmans Island Breakwater Light No. 4, Cal., was collided with by an unknown vessel, causing damage to the light in the estimated amount of \$600.

On September 26, 1916, Alviso Channel Beacon No. 9, Cal., was collided with by an unknown vessel. The beacon was replaced by the Government at a cost of \$148.20.

On October 19, 1916, Petaluma Creek Light No. 1, Cal., was knocked down by the tug *Lou Chandler* with a barge in tow, causing damage to the light in the estimated amount of \$600. The light was rebuilt by the owners of the barge.

On December 31, 1916, San Diego Bay Beacon No. 1, Cal., was collided with by the steamer *Saginaw*, inflicting damages to the beacon in the amount of \$220, which were paid for by the owners of the vessel.

On January 21, 1917, Indian Island Spit Light, Cal., was collided with by the steamer *Antelope*, destroying the lens lantern and doing other damage to the structure. The entire cost of repairs was borne by the owners of the vessel.

On April 19, 1917, San Diego Bay Light No. 6, Cal., was collided with by the tug *Bahada*, causing damages estimated at \$600. Steps have been taken to have the owners of the tug make the necessary repairs.

The following damage to private property was caused by vessels of the Lighthouse Service during the year:



On April 10, 1917, relief light vessel No. 66, Mass., collided with the end of the dock of the Metropolitan Coal Co., inflicting damages to the dock estimated at \$100.

On June 21, 1917, Great Round Shoal Light Vessel No. 86, Mass., collided with the end of the wharf of the Pocahontas Fuel Co., inflicting damages to the wharf estimated at \$125.

On May 25, 1917, the tender *Dandelion* collided with launch owned by Arthur Hugins, inflicting damages to the launch in the estimated amount of \$25.

The Lighthouse Service was responsible for these three collisions, and in accordance with section 4 of the act approved June 17, 1910 (36 Stat., 537), estimates will be submitted to Congress in the amounts mentioned.

### PUBLICATIONS OF THE LIGHTHOUSE SERVICE.

[All publications are at present distributed free.]

Publications.	Date of last edition.	Cost of last edition.	Number distributed.
<b>Light lists:</b>			
Atlantic and Gulf coasts of United States.....	Jan. 1, 1917	\$4, 370	9, 158
Pacific coast of United States, etc.....	do.....	1, 289	2, 437
Great Lakes of United States and Canada.....	Apr. 1, 1917	849	1, 331
Upper Mississippi River and tributaries.....	Jan. 15, 1917	546	968
Ohio River and tributaries.....	Sept. 15, 1916	126	873
Lower Mississippi River and tributaries.....	Oct. 15, 1916	283	694
<b>Buoy lists:</b>			
First district.....	May 1, 1916	942	4, 843
Second district.....	do.....	739	5, 109
Third district.....	May 1, 1917	1, 446	5, 282
Fourth district.....	June 1, 1917	335	3, 772
Fifth district.....	July 1, 1917	1, 800	3, 998
Sixth district.....	Mar. 1, 1916	728	3, 015
Seventh district.....	Apr. 1, 1916	414	3, 476
Eighth district.....	Sept. 1, 1916	704	2, 896
Ninth district.....	July 1, 1917	130	1, 024
Tenth district.....	Apr. 1, 1917	211	1, 196
Eleventh district.....	do.....	531	1, 100
Twelfth district.....	do.....	349	1, 125
Sixteenth district.....	June 1, 1917	315	501
Seventeenth district.....	June 1, 1916	476	1, 258
Eighteenth district.....	do.....	260	1, 315
Nineteenth district.....	July 1, 1917	157	990
<b>Miscellaneous publications:</b>			
Weekly Notice to Mariners.....	1917	3, 584	170, 800
Annual Report, Commissioner of Lighthouses—			
Part I.....	1916	691	1, 170
Part II.....	1916	352	.....
Regulations for the United States Lighthouse Service.....	1914	787	36
Medical handbook.....	1915	633	119
Lighthouse Service bulletins.....	1917	206	18, 000
Regulations for lighting bridges.....	1915	202	129
Regulations for uniforms.....	1912	70	3
Civil-service regulations.....	1913	73	3
Instructions for coast keeping.....	1914	120	50
Instructions to employees.....	1915	408	55
The United States Lighthouse Service.....	1915	508	247

### COST OF PRINTING FOR THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1917.

Light lists.....	\$7, 835. 95
Buoy lists.....	5, 430. 37
Notices to mariners.....	3, 743. 12
Annual Report, Part I.....	691. 41
Annual Report, Part II.....	352. 04
Specifications and other publications.....	264. 48
Forms, reports, record books, etc.....	4, 777. 73
<b>Total.....</b>	<b>23, 095. 10</b>

**MONEY RECEIVED BY THE LIGHTHOUSE SERVICE AND TURNED INTO  
THE TREASURY, FISCAL YEAR 1917.**

District.	From sales of property.	From damages to aids to navigation and other property.	From leases and rentals.	Total.
1st.....	\$1,046.48			\$1,046.48
2d.....	1,000.00	\$96.28	\$161.91	1,258.19
3d.....	4,394.44	571.95	359.00	5,325.39
4th.....	399.33	94.13	5.00	498.46
5th.....	4,423.29	25.00		4,448.29
6th.....	269.61	89.29	24.80	383.70
7th.....	367.50		132.90	500.40
8th.....	459.24	516.28	20.00	995.52
10th.....	1,239.66	18.44	468.49	1,726.59
11th.....	447.45		1.00	448.45
12th.....	28.00			28.00
14th.....	292.56	63.00		355.56
16th.....	320.62	474.15	315.00	1,109.77
18th.....	1,841.37	438.50	1,839.50	4,119.37
19th.....	40.00			40.00
Bureau.....		105.07		105.07
<b>Total.....</b>	<b>17,038.59</b>	<b>2,566.32</b>	<b>4,489.09</b>	<b>24,094.20</b>

**APPROPRIATIONS FOR THE BUREAU OF LIGHTHOUSES AND THE  
LIGHTHOUSE SERVICE, SIXTY-FOURTH CONGRESS, SECOND SESSION,  
AND SIXTY-FIFTH CONGRESS, FIRST SESSION, 1916-17.**

Title.	Act.	Amount.
<b>Maintenance:</b>		
Salaries, Bureau of Lighthouses, 1918.....	Legislative, Mar. 3, 1917.....	\$64,030
General expenses, Lighthouse Service, 1918.....	Sundry civil, June 12, 1917.....	2,850,000
Salaries of keepers of lighthouses, 1918.....	do.....	940,000
Salaries, lighthouse vessels, 1918.....	do.....	1,104,650
Salaries, Lighthouse Service, 1918.....	do.....	380,000
<b>Total for maintenance.....</b>		<b>5,338,680</b>
<b>Special works:</b>		
Light vessels for general lake service.....	Sundry civil, June 12, 1917.....	150,000
Radio installations on lighthouse tenders.....	do.....	60,000
Staten Island Lighthouse Depot, N. Y.....	do.....	21,000
Tender for third lighthouse district.....	do.....	150,000
Aids to navigation, East River, N. Y.....	do.....	16,000
Great Salt Pond Light Station, R. I.....	do.....	20,000
Cape Charles Light Vessel, Va.....	do.....	130,000
Aids to navigation, Cape Charles City, Va.....	do.....	12,800
Aids to navigation, Chesapeake Bay, Md. and Va.....	do.....	20,000
Point Borinquen Light Station, P. R.....	do.....	85,000
Aids to navigation, Huron Harbor, Ohio.....	do.....	4,500
Aids to navigation, Fairport Harbor, Ohio.....	do.....	42,000
Sand Hills Light Station, Mich.....	do.....	70,000
Aids to navigation, Keweenaw Waterway, Mich.....	do.....	105,000
Chicago Harbor Light Station, Ill.....	do.....	88,000
Manitowoc Breakwater Light Station, Wis.....	do.....	21,000
Aids to navigation, Indiana Harbor, Ind.....	do.....	100,000
Aids to navigation, Alaska.....	do.....	60,000
Aids to navigation, Washington and Oregon.....	do.....	35,000
Aids to navigation, Pearl Harbor, Hawaii.....	do.....	80,000
Aransas Pass Light Station, Tex.....	Urgent deficiency, Oct. 6, 1917.....	20,000
<b>Total for special works.....</b>		<b>1,299,300</b>
<b>Grand total.....</b>		<b>6,637,980</b>

# EXPENDITURES DURING THE FISCAL YEAR 1917 FROM APPROPRIATIONS FOR THE LIGHTHOUSE SERVICE.

[Obligations incurred are not included.]

## MAINTENANCE APPROPRIATIONS.

<b>Salaries:</b>	
Bureau of Lighthouses, 1916.....	\$2, 834. 65
Bureau of Lighthouses, 1917.....	58, 778. 22
Expenses of buoyage: Certified claims.....	45. 64
Supplies of lighthouses: Certified claims.....	61. 84
<b>Salaries of keepers of lighthouses:</b>	
1916.....	23, 797. 64
1917.....	903, 643. 22
<b>Lighting of rivers: Certified claims.....</b>	<b>12. 89</b>
<b>Salaries, lighthouse vessels:</b>	
1916.....	28, 488. 70
1917.....	998, 584. 48
<b>Expenses of light vessels: Certified claims.....</b>	<b>24. 48</b>
<b>Salaries, Lighthouse Service:</b>	
1916.....	3, 796. 58
1917.....	362, 981. 89
<b>General expenses, Lighthouse Service:</b>	
1915.....	22, 345. 38
1916.....	491, 276. 34
1917.....	2, 323, 542. 82
Certified claims.....	258. 30
<b>Total maintenance.....</b>	<b>5, 220, 473. 07</b>

## SPECIAL WORKS.

<b>General:</b>	
Tender for first lighthouse district.....	56, 385. 42
Tender for fifteenth lighthouse district.....	678. 80
Light vessels for general service.....	64, 438. 38
Lighthouse tender, general service.....	78, 711. 22
Oil houses for light stations.....	873. 62
Claims for damages by collision with lighthouse vessels.....	56. 88
<b>Second district:</b>	
Cape Cod Canal Lights, Mass.....	2, 872. 28
Woods Hole Lighthouse Depot, Mass.....	33, 171. 69
<b>Third district:</b>	
Staten Island Lighthouse Depot, N. Y. (carpenter shop).....	10, 915. 30
Newark Bay Beacon Lights, N. J.....	1, 538. 38
Aids to Navigation, Hudson River, N. Y.....	40. 66
Hunts Point Light Station, N. Y.....	3, 520. 21
<b>Fourth district:</b>	
Aids to navigation, Delaware River, Pa. and Del.....	14, 599. 06
<b>Fifth district:</b>	
Thimble Shoal Light Station, Va.....	70. 94
Lighting Norfolk Harbor, Va.....	1, 537. 08
Fort McHenry Channel Range Lights, Md.....	446. 77
<b>Sixth district:</b>	
Tender for engineer, sixth lighthouse district.....	23, 173. 90
Depot for sixth lighthouse district.....	4, 697. 89
Aids to navigation, St. Johns River, Fla.....	12, 406. 50
<b>Seventh district:</b>	
Aids to navigation, Florida Reefs, Fla.....	1, 127. 00
<b>Eighth district:</b>	
Tender and barge, eighth lighthouse district.....	13. 14
Galveston Jetty Light Station, Tex.....	1, 347. 34
Southwest Pass Light Vessel, Mississippi River, La.....	44, 326. 00
Aids to navigation, Atchafalaya Entrance Channel, La.....	13, 091. 90
Repairing and rebuilding aids to navigation, Gulf of Mexico.....	119, 575. 56
Aids to navigation, Mississippi River, La.....	567. 57
<b>Ninth district:</b>	
Navassa Island Light Station, W. I.....	58, 050. 16

## Tenth district:

Cleveland Fog-Signal Station, Ohio.....	\$4,300.13
Aids to navigation, Ashtabula Harbor, Ohio.....	11,656.74
Aids to navigation, Lorain Harbor, Ohio.....	27,340.37
Aids to navigation, Conneaut Harbor, Ohio.....	704.43
Aids to navigation, Toledo Harbor, Ohio.....	143.00

## Eleventh district:

Aids to navigation, Fighting Island Channel, Mich.....	8,399.25
Detroit River lights, Mich.....	930.16
Superior Pierhead Range Lights, Wis.....	124.58

## Twelfth district:

Milwaukee Light Vessel, Wis.....	240.00
Aids to navigation, Manistique, Mich.....	1,250.33

## Sixteenth district:

Aids to navigation, Alaska.....	8,194.71
Cape St. Elias Light Station, Alaska.....	35,247.32

## Seventeenth district:

Aids to navigation, Puget Sound, Wash.....	5,226.14
Aids to navigation, Coquille River, Oreg.....	36.34
Kellett Bluff Light Station, Wash.....	1,258.34

## Eighteenth district:

Point Vicente Light Station, Cal.....	13.50
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Total, special works.....	651,298.99
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Total, maintenance appropriations.....	5,220,473.07
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Total, special works.....	651,298.99
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Grand total.....	5,871,772.06
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**ITEMIZED ESTIMATES OF APPROPRIATIONS FOR THE FISCAL YEAR 1919, AND ITEMIZED STATEMENT OF EXPENDITURES FOR THE FISCAL YEAR 1917, AS REQUIRED BY THE ACT OF CONGRESS APPROVED JUNE 25, 1910 (36 STAT., 755).**

[The expenditures herein stated are in part estimated, owing to the fact that all obligations incurred for the year 1917 have not yet been settled. Articles of supplies purchased for general stock have also been distributed, approximately, to features to be benefited. This table refers to appropriations made in the sundry civil appropriation act and does not include Bureau salaries in Washington nor the cost of publications, otherwise provided for. This statement contains also amounts for salaries and wages under certain items which are shown separately in the Book of Estimates, 1919.]

Item.	Estimate, 1919.	Expenditures, 1917.	Item.	Estimate, 1919.	Expenditures, 1917.
<b>GENERAL EXPENSES, LIGHTHOUSE SERVICE.</b>			<b>GENERAL EXPENSES, LIGHTHOUSE SERVICE—contd.</b>		
Lights and fog signals:			Offices—Continued.		
Rations and provisions.....	\$228, 200	\$161, 232	Telegraph and telephone....	\$8, 500	\$8, 406
Fuel and rent for keepers....	74, 000	56, 783	Traveling expenses and mileage.....	37, 000	35, 621
General supplies.....	315, 000	226, 812	Rent.....	3, 000	2, 764
Repairs and improvements, including grounds and outbuildings.....	420, 000	349, 855	Freight, expressage, and cartage.....	35, 000	34, 100
Establishing lights and fog signals, including sites.....	53, 000	33, 254	Motorcycle, Hawaiian Islands.....	150	75
Necessary additional land for light stations.....	1, 500	300	Incidental expenses.....	3, 100	2, 536
Oil and carbide houses.....	2, 000	1, 201	Total.....	3, 608, 800	2, 786, 030
Incidental expenses.....	8, 000	11, 022	Appropriation, 1918, \$2, 550, 000.		
Daymarks and spindles:			Appropriation, 1917, 940, 000.		
Establishment, including sites.....	2, 000	5, 200	<b>SALARIES OF KEEPERS OF LIGHTHOUSES.</b>		
Repairs and improvements.	10, 000	6, 845	Salaries of lighthouse keepers.	1, 080, 000	933, 525
Incidental expenses.....	250	78	Appropriation, 1918, \$940, 000.		
Post lights:			Appropriation, 1917, 940, 000.		
Establishment.....	9, 100	2, 897	<b>SALARIES, LIGHTHOUSE VESSELS.</b>		
Wages of laborers attending lights.....	225, 000	223, 136	Salaries and wages, lighthouse tenders.....	1, 110, 000	667, 654
Supplies.....	30, 000	29, 236	Salaries and wages, light vessels.....	540, 000	373, 813
Repairs and improvements.	23, 000	21, 979	Total.....	1, 650, 000	1, 041, 467
Incidental expenses.....	1, 000	1, 181	Appropriation, 1918, \$1, 104, 650.		
Buoys:			Appropriation, 1917, 1, 070, 000.		
Establishment.....	215, 150	83, 537	<b>SALARIES, LIGHTHOUSE SERVICE.</b>		
Supplies.....	42, 000	24, 299	Salaries, executive and technical.....	141, 000	125, 656
Repairs.....	66, 000	49, 662	Salaries, clerical and messenger.....	141, 000	136, 069
Incidental expenses.....	750	969	Salaries, authorized depot force.....	109, 000	106, 323
Tenders:			Total.....	391, 000	368, 068
Rations and provisions.....	294, 000	202, 501	Appropriation, 1918, \$380, 000.		
Supplies.....	492, 800	381, 115	Appropriation, 1917, 375, 000.		
Repairs.....	247, 000	224, 636			
Incidental expenses.....	6, 000	5, 709			
Light vessels:					
Rations and provisions.....	133, 000	95, 198			
Supplies.....	161, 000	119, 331			
Repairs.....	192, 000	156, 044			
Incidental expenses.....	2, 000	1, 118			
Depots:					
Pay of laborers and mechanics.....	80, 000	60, 945			
Rent.....	5, 500	4, 860			
Repairs and improvements.	144, 000	129, 767			
Incidental expenses.....	17, 000	18, 431			
Offices:					
Technical books and periodicals.....	500	571			
Stationery and office supplies.....	22, 300	12, 562			

NOTE.—Under appropriation "General Expenses, Lighthouse Service," it is proposed during the fiscal year 1919 to authorize per diem in lieu of subsistence, pursuant to the act of August 1, 1914, at rates of from \$2 to \$4.

## SUMMARY OF ESTIMATES OF APPROPRIATIONS FOR THE LIGHTHOUSE SERVICE FOR THE FISCAL YEAR 1919.

## FOR GENERAL MAINTENANCE OF THE LIGHTHOUSE SERVICE.

Salaries, Bureau of Lighthouses.....	\$67, 030
General expenses, Lighthouse Service.....	3, 608, 800
Salaries, Lighthouse Service.....	391, 000
Salaries, keepers of lighthouses.....	1, 080, 000
Salaries, lighthouse vessels.....	1, 650, 000
Total.....	<u>6, 796, 830</u>

## FOR SPECIAL WORKS.

Group 1. Works urgently necessary for the safety or immediate needs of navigation and for the preservation of existing structures or equipment, for the full utilization of other public improvements, or for the efficient equipment of the Lighthouse Service:

1. Guantanamo, Cuba, improvements.....	14, 000
2. Lighthouse depot for second district, construction.....	85, 000
3. Detroit, Mich., improvements to lighthouse depot.....	53, 000
4. Hawaiian Islands lighthouse depot, construction and equipment..	90, 000
5. Light-keepers' dwellings, construction.....	75, 000

NOTE.—All of the foregoing items have been authorized by law.

6. Sand Island Light Station, Ala., improvements.....	45, 000
7. Light vessel for Gulf coast, Louisiana, or for general service.....	160, 000
8. Spectacle Reef Light Station, Mich., improvements.....	28, 000
9. Lighthouse depot for fifth district, enlargement, improvement, or establishment of new depot.....	275, 000
10. Lighthouse tender, to replace tender <i>John Rodgers</i> , or for general service.....	200, 000
11. Lighthouse tender, to replace tender <i>Jessamine</i> , or for general service.....	200, 000
12. Ambrose Channel, N. Y., aids to navigation.....	26, 000
13. Joe Flogger Shoal, N. J. and Del., aids to navigation.....	40, 000
14. St. Marys River, Mich., aids to navigation.....	80, 000
15. Staten Island Lighthouse Depot, N. Y. improvements.....	30, 000
16. Additional gas buoys, fifth lighthouse district.....	65, 000
17. Lighthouse tender to replace tender <i>Holly</i> , or for general service..	200, 000
18. Virgin Islands, West Indies, aids to navigation.....	50, 000
19. Staten Island Lighthouse Depot, N. Y., improvement and extension of wharves.....	120, 000
20. Potomac River, Md., aids to navigation.....	95, 000
Authorized by law.....	317, 000
Not authorized.....	1, 614, 000

Total, group 1..... 1, 931, 000

Group 2. Works considered essential for the needs of navigation and the equipment of the Lighthouse Service, and which it is recommended be undertaken as resources permit, are submitted with estimates of cost. (These items have been selected from a much larger number of recommendations submitted by the inspectors of the lighthouse districts and others.)

21. Charleston Lighthouse Depot, S. C., improvements.....	75, 000
22. Key West Lighthouse Depot, Fla., establishing.....	175, 000
23. New Orleans Lighthouse Depot, La., establishing.....	105, 000
24. Ludington, Mich., aids to navigation.....	43, 000
25. Tampa Bay, Fla., aids to navigation.....	15, 000
26. Delaware Bay entrance, improvement of aids to navigation.....	148, 000
27. Goose Island Flats, N. J., establishment of light and fog-signal station.....	140, 000
28. Alaska, lighthouse depot, purchase of site and construction and equipment.....	90, 000
29. California and Nevada, aids to navigation.....	30, 000
30. Goat Island Lighthouse Depot, Cal., improvements.....	55, 000
31. Point Pinos Light Station, Cal., improvement.....	35, 000
32. Michigan Island, Wis., establishment of light and fog-signal station.....	100, 000

## Group 2—Continued.

33. Kauhola Point Light Station, Hawaii, improvement.....	\$20, 000
34. Anacapa Island, Cal., establishment of light and fog-signal station.....	115, 000
35. Santa Barbara Light Station, Cal., improvements.....	28, 000
36. Cape Spencer, Alaska, establishment of light and fog-signal station.....	125, 000
37. Staten Island Lighthouse Depot, N. Y., drydock.....	130, 000
38. Portage Lake, Mich., establishment of light and fog-signal station and improvement of aids.....	100, 000
39. Ram Island, Me., establishment of light.....	3, 500
40. Cape Kumukahi, Hawaii, establishment of light.....	22, 000
41. Henderson Point, Me., establishment of light and fog signal.....	4, 900
42. Port Real, P. R., establishment of light station.....	40, 000
43. Nine Mile Point, Mich., establishment of light and fog-signal station.....	50, 000
44. Caribbean Sea, aids to navigation.....	75, 000
45. Galveston Jetty Light Station, Tex., improvements.....	8, 500
46. Grays Harbor Light Station, Wash., improvements.....	15, 000

Total, group 2 (not included in total of estimates)..... 1, 747, 900

## RECAPITULATION.

For general maintenance of the Lighthouse Service.....	6, 796, 830
For special works: Group 1.....	1, 931, 000

Total..... 8, 727, 830

## DETAILED ESTIMATES FOR MAINTENANCE, 1919.

## BUREAU OF LIGHTHOUSES.

Salaries.....	\$67, 030
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## GENERAL EXPENSES, LIGHTHOUSE SERVICE.

For supplies, repairs, maintenance, and incidental expenses of lighthouses and other lights, beacons, buoyage, fog signals, lighting of rivers heretofore authorized to be lighted, light vessels, other aids to navigation, and lighthouse tenders, including the establishment, repair, and improvement of beacons and day marks and purchase of land for same; the establishment of post lights, buoys, submarine signals, and fog signals; the establishment of oil or carbide houses not to exceed \$10,000: *Provided*, That any oil or carbide house erected hereunder shall not exceed \$550 in cost; the construction of necessary outbuildings at a cost not exceeding \$500 at any one light station in any fiscal year; the improvements of grounds and buildings connected with light stations and depots; rebuilding light stations and depots and buildings connected therewith; wages of laborers attending post lights; pay of temporary employees and field force while engaged on works of general repair and maintenance and pay of laborers and mechanics at lighthouse depots; rations and provisions or commutation thereof for keepers of lighthouses, working parties in the field, officers and crews of light vessels and tenders, and officials and other authorized persons of the Lighthouse Service on duty on board of such tenders or vessels; and money accruing from commutation for rations and provisions for the above-named persons on board of tenders and light vessels or in working parties in the field may be paid on proper vouchers to the person having charge of the mess of such vessel or party, reimbursement under rules prescribed by the Secretary of Commerce of keepers of light stations and masters of light vessels and of lighthouse tenders for rations and provisions and clothing furnished shipwrecked persons who may be temporarily provided for by them, not exceeding in all \$5,000 in any fiscal year; fuel and rent of quarters where necessary for keepers of lighthouses; the purchase of land sites for fog signals; the rent of necessary ground for all such lights and beacons as are for temporary use or to mark changeable channels and which in consequence can not be made permanent; the rent of offices, depots, and wharves; traveling expenses, mileage, library books for light stations and vessels, and technical books and periodicals not exceeding \$1,000; and for all other contingent expenses of district offices and depots and not exceeding \$10,000 for contingent expenses of the Office of the Bureau of Lighthouses in Washington, \$3,608,800.

Hereafter the appropriation, "General expenses, Lighthouse Service," shall be available, under regulations prescribed by the Secretary of Commerce, for the payment of traveling and subsistence expenses of teachers while actually employed by States or private persons to instruct the children of keepers of lighthouses.

Hereafter all officers and employees engaged in the field service or on vessels of the Lighthouse Service who shall have reached the age of 65 years, after having been 30 years in the active service of the Government, may, at their option, be retired from further performance of duty; and all such officers and employees who shall have reached the age of 70 years shall be compulsorily retired from further performance of duty: *Provided*, That the annual compensation of persons so retired shall be a sum equal to one-fortieth of the last annual pay received for each year of active service in the Lighthouse Service, or in a department or branch of the Government having a retirement system, not to exceed in any case thirty-fortieths of the last annual pay received: *Provided further*, That such retirement pay shall not include any amount on account of subsistence or other allowance.

Hereafter every lighthouse keeper and assistant lighthouse keeper in the Lighthouse Service of the United States shall be entitled to receive one ration per day, or, in the discretion of the Commissioner of Lighthouses, commutation therefor at the rate of 45 cents per ration.

Hereafter the Secretary of Commerce is authorized to provide, under regulations to be prescribed by him, for the sale of publications of the Bureau of Lighthouses and the Lighthouse Service, including the allowance of a commission for such sales.

Hereafter post-lantern lights and other aids to navigation may be established and maintained, in the discretion of the Commissioner of Lighthouses, out of the annual appropriations for the Lighthouse Service on Lakes Union and Washington, in the State of Washington.

**NOTE.**—The amount estimated for is \$753,800 in excess of the appropriation for the fiscal year 1917, made necessary on account of the general expansion of the Service and the great advance in the cost of all commodities.

An increase of appropriation is considered necessary on account of the increase in numbers of aids required for the safety of navigation, to keep the Lighthouse Service in an economical state of repair and efficiency, and because of the recent extraordinary advance in the price of labor and materials. The total number of aids was increased in 1917 from 14,947 to 15,222, an increase of 275, or 1.9 per cent. In order to keep pace with the constant development of commerce it is believed that proper provision for maintenance and repair as well as for the establishment of necessary additional minor aids frequently requested by mariners should be made. With the increasing numbers of requests for aids, it is impossible to render the full efficiency and service demanded unless adequate provision is made for funds. With respect to the general advance in prices of commodities, it may be stated that many items, such as steel plate and paints and paint materials, have advanced as high as three or four times normal figures, while practically all articles have advanced 25 per cent or over. It has been found necessary to estimate on a 40 per cent increase for all items in the appropriations covering the purchase of supplies and materials. Further expense will be incurred by the taking over of the lighthouse service of the Virgin Islands, West Indies, under Executive order of July 20, 1917. It is, therefore, believed that the additional amount requested is conservative in view of the circumstances.

The foregoing estimate of appropriation for "General expenses, Lighthouse Service," includes a provision which is submitted for "rebuilding light stations and depots and buildings connected therewith." Property of the Lighthouse Service is very much exposed to storms, and damage amounting to an average of \$100,000 per annum or upwards has been occasionally sustained from this cause. When the damage in any one locality is very extensive, it is necessary to ask Congress for a special appropriation to repair and rebuild the aids to navigation damaged or destroyed. However, it frequently happens that the rebuilding of a light station or depot or building connected therewith which has been destroyed is urgently needed, not permitting of the delay of securing a special appropriation from Congress, and also that funds may be spared from the appropriation "General expenses, Lighthouse Service," to accomplish the work. The Comptroller of the Treasury has held (decision of June 19, 1917) that the appropriation "General expenses, Lighthouse Service," does not contain authority for rebuilding such structures. It is considered to be in the interest of effectively maintaining the Lighthouse Service that provision for this purpose be made in the appropriation as recommended.

The estimate of appropriation for "General expenses, Lighthouse Service," also includes a provision for allowing commutation of rations and provisions to working parties of the Lighthouse Service in the field. The members of working parties of the Lighthouse Service are furnished their subsistence when employed away from their homes and stations, but there is no authority for commuting the allowance, it being necessary either to provide subsistence in kind or reimburse the individuals for expenditures made by them for this purpose. It will facilitate the work of subsisting field parties and reduce the amount of clerical work in district offices if authority for commuting this subsistence is granted.



Authority is also requested for the payment of travel and subsistence expenses of teachers while engaged in instructing the children of lighthouse keepers. The question of providing proper educational facilities for children at isolated light stations is a matter that has received careful attention, and in some localities, notably in the State of Maine, the State educational authorities have made provision for traveling teachers to instruct children at outlying stations, while ordinary school facilities are otherwise practically impossible. The State pays the teacher and provides the school books, and it is considered proper that the Lighthouse Service should cooperate in this meritorious work to the extent of providing for the travel and subsistence expenses of the teachers. Under the existing arrangements these expenses are paid in part by the State and by the keepers, and it is believed that a hardship is thus created on the keepers, who under their present very moderate salaries, can hardly afford such additional expenses. It may also be stated that in other Lighthouse Services, such as that of England, assistance is given toward the education of keepers' children by a so-called "educational grant," being an extra allowance of money for each child between the ages of 5 and 15 years at specified isolated stations, for expense in boarding out and educating such children.

The item of legislation recommended above for the retirement of superannuated persons has been explained in the narrative portion of this annual report, on page 28. It is estimated that approximately \$150,000 per annum would be required to provide for the compensation of persons retired under its provisions.

The above proposed legislation to provide for an increase in the ration allowance to lighthouse keepers is a restatement of the act of May 14, 1908, section 9 (35 Stat., 163), with the rate of commutation increased from 30 cents to 45 cents per ration. The sundry civil appropriation act of June 12, 1917, contains a provision for rations or commutation thereof at the rate of 45 cents per ration for warrant officers, petty officers, and other enlisted men of the Coast Guard, the rate for such commutation having been previously 30 cents per ration. The extraordinary advance in the cost of foodstuffs makes the allowance of 30 cents per ration insufficient, and it is recommended that the commutation of rations for lighthouse keepers and assistant lighthouse keepers in the Lighthouse Service be increased to 45 cents per ration, as was done for the persons mentioned in the Coast Guard.

With reference to the authority requested for the sale of lighthouse publications, it is considered that the present free system of distribution is wasteful. The Bureau, in cooperation with the Division of Publications of the Department and the Superintendent of Documents, Government Printing Office, has been endeavoring to devise some means whereby a nominal price may be placed on these publications. However, in arranging the details of this matter, business difficulties have arisen with private booksellers and agencies outside of the Government service, who decline to make the necessary returns of cash, stocks on hand, etc., unless a commission is allowed on sales, following the usual commercial practice in this respect. Recommendation for legislation to overcome this difficulty is, therefore, submitted, providing for the sale of such publications with the allowance of commissions under proper regulations. This matter has been thoroughly canvassed, and the opinion is general that a nominal charge for lighthouse publications is an economical and businesslike arrangement. The charge will not prove burdensome to those who have a genuine use for the publications and will prevent their wasteful distribution.

Authority is also requested to cover the establishment and maintenance of post-lantern lights and other aids to navigation on Lakes Union and Washington, in the State of Washington.

The completion of the Lake Washington Shipping Canal in Seattle, Wash., which was opened July 4, 1917, permits deep-sea shipping to enter Lakes Union and Washington, and it is expected that heavy tonnage will enter these inland water bodies. There are also several ferry lines now running in Lake Washington. At present the jurisdiction of the Lighthouse Service is limited to the tidal waters of Puget Sound; and Lakes Union and Washington, although connected with the sound by the canal, are not tidal waters, and, therefore, the Lighthouse Service is without authority to maintain aids to navigation thereon, its jurisdiction being restricted to tidal waters, except as otherwise specifically authorized by Congress.

It is further recommended that consideration be given to the consolidation of the four general maintenance appropriations under the single appropriation "General expenses," by naming in the consolidated general appropriation a specific amount as the limit of all salary items included therein. It is believed that this step would effect a more economical and efficient administration of the Lighthouse Service by simplification of the accounting system, and permitting the costs of work to be kept in a more systematic and comprehensive manner, showing clearly for each principal feature the relative amounts paid for salaries, materials, supplies, equipment, and other component items. Among additional advantages of consolidation of items of

general appropriation may be stated the following: (a) Laborers in charge of lights are now paid out of two different appropriations, those attending lights on rivers authorized by Congress to be lighted being paid out of general expenses, and those at other lights not on rivers being paid out of salaries of keepers; (b) commutation of rations of keepers and other employees (which may be properly considered as part of their compensation) now must be paid out of the appropriation "General expenses," while the salaries proper are paid out of the respective salary appropriations; (c) the items recommended for consolidation have natural limitations. For example, the number and average salary of keepers is limited by law. A necessary limitation is also imposed by the number of vessels in service. If such a consolidation of appropriations may be effected, it is believed that the total sum of the four general maintenance appropriations stated in these estimates, viz, \$6,729,800, may be reduced in the sum of \$25,000 to a revised total of \$6,704,800. This may be effected by reason of the fact that it is necessary to allow a small portion of each appropriation to be reserved for prevention of a deficiency prohibited by law, and if the appropriations be consolidated the amount reserved may be correspondingly reduced.

(See p. 720 for itemized estimate.)

#### SALARIES, KEEPERS OF LIGHTHOUSES.

For salaries of not exceeding 1,800 lighthouse and fog-signal keepers and laborers attending other lights, exclusive of post lights, \$1,080,000.

Section 4673 of the Revised Statutes of the United States is hereby amended to read as follows:

"SEC. 4673. The Secretary of Commerce is authorized to regulate the salaries of the respective keepers of lighthouses in such manner as he deems just and proper, but the whole sum allowed for such salaries shall not exceed an average of \$700 per annum to each keeper; and the authority herein granted to regulate the salaries of keepers of lighthouses shall not be abridged or limited by the provisions of section 7 of the general deficiency appropriation act approved August 26, 1912, as amended by section 4 of the legislative, executive, and judicial appropriation act approved March 4, 1913."

NOTE.—The foregoing estimates of appropriation call for an increase of \$140,000 over the appropriation of \$940,000 made for this purpose for the fiscal year 1918. It is based on proposed schedules of pay which shall provide an average salary of \$600, authorized in Revised Statutes, section 4673, to the full number of persons (1,800) provided for in the appropriation act. The present average salary is about \$556, but the present cost of all means of subsistence makes such pay inadequate, and it is considered both necessary and just to provide a higher rate of compensation for this worthy class of employees. Recommendation is also submitted for legislation to provide for an increase in the authorized average salary of lighthouse keepers from \$600 to \$700 per annum, which when granted will require additional appropriation, to be taken up at a later time.

(See p. 720 for itemized estimate.)

#### SALARIES, LIGHTHOUSE VESSELS.

For salaries and wages of officers and crews of light vessels and lighthouse tenders, including temporary employment when necessary, \$1,650,000.

NOTE.—The amount estimated for is \$545,350 in excess of the appropriation for the fiscal year 1918, and is caused by the unprecedented situation in shipping conditions, making it quite impossible to obtain seamen, firemen, cooks, etc., at the former recognized standard rates of pay. At the direction of the Secretary of Commerce and with the approval of the President the foregoing estimate is based on pay schedules which are in conformity with the agreement reached between the Department of Labor, the Department of Commerce, the Shipping Board, and representatives of both employees and employers. A further and fuller statement of this situation is found in this report at p. 674.

(See p. 720 for itemized estimate.)

#### SALARIES, LIGHTHOUSE SERVICE.

For salaries of 17 lighthouse inspectors, and of clerks and other authorized permanent employees in the district offices and depots of the Lighthouse Service, exclusive of those regularly employed in the office of the Bureau of Lighthouses, Washington, D. C., \$391,000.

NOTE.—An increase of \$11,000 over the appropriation for the fiscal year 1918 is submitted, consisting of the following:

To make up present deficiency.....	\$6,000
Additional clerks and draftsmen.....	5,000
Total.....	11,000

The item of \$5,000 is occasioned by the general growth of the Service in order that the technical and clerical work of the district offices may be dispatched promptly. About five positions at salaries ranging from \$900 to \$1,500 per annum will be thus provided for.

### DETAILED ESTIMATES FOR SPECIAL WORKS, 1919.

#### GROUP No. 1.

Works urgently necessary for the safety or immediate needs of navigation and for the preservation of existing structures or equipment, for the full utilization of other public improvements, or for the efficient equipment of the Lighthouse Service.

No. 1. *Guantanamo, Cuba, aids to navigation.*—For dwelling for keepers of the lights in Guantanamo Bay, Cuba, and improving the lighting, \$14,000.

NOTE.—The act of July 27, 1912 (39 Stat., 239), authorized the construction of these works, but no appropriation was made therefor. The dwelling at this station was destroyed during the insurrection following the war of 1898, and since the occupation of Guantanamo by the United States the keepers have been compelled to live in a wooden shack with only three rooms and an old stable to house three keepers. The lights in charge of these three keepers are widely separated. With the installation of acetylene lights as proposed, the service of one keeper may be dispensed with. Detailed estimate:

Dwelling for two keepers.....	\$5,000
2 acetylene lights at Fisherman Point.....	2,800
2 acetylene lights at Hicacal Beach.....	2,800
Contingencies.....	400
Total.....	14,000

No. 2. *Depot for second lighthouse district.*—For constructing and equipping a lighthouse depot for the second lighthouse district, \$85,000.

NOTE.—The act of August 28, 1916 (39 Stat., 537), authorized this work, but no appropriation was made therefor. The present depot of the second district for Boston Harbor and vicinity is on Lovells Island, and is there through the courtesy of the War Department only. It is not adapted or situated for a depot where the work can be carried on expeditiously. Lighthouse tenders can not lie there nights on account of being exposed to the weather, and passing steamers make such a swash that the tender's lines are parted. The tide has been known to cover the floor of the storehouse to a depth of 1 foot. The buildings, with the exception of the oil house, are wooden, and in poor condition of repair. The wharf is also in poor condition of repair. The Treasury Department has transferred a piece of the old marine hospital property in Chelsea to the Lighthouse Service which is suitable as a site for a lighthouse depot. This property by dredging will have three berths for vessels, ample storage room for buoys, and with a brick fire-proof storehouse would make a first-class depot. Detailed estimate:

Wharf.....	\$13,576
Sea wall.....	21,606
Oil house.....	2,160
Service building.....	18,450
Depot keeper's dwelling.....	8,400
Storehouse.....	4,320
Machine and blacksmith shop.....	3,000
Buoy skid and chain platform.....	1,500
Dredging.....	9,000
Excavating and laying water pipes.....	800
Boundary fence.....	2,088
Total.....	85,000

No. 3. *Detroit, Mich., lighthouse depot.*—For improvements at Detroit, Mich., lighthouse depot, \$53,000.

NOTE.—The act of August 28, 1916 (39 Stat., 537), authorized this work, but no appropriation was made therefor. The following improvements are needed:

Addition to lamp shop: The present lamp shop is greatly overcrowded, owing to the increasing number of lighted buoys and other aids in the district, necessitating a greater and increasing quantity of parts returned for repair. Spare parts can not be accommodated but must be stored in the main storehouse, inconveniently located for the work. It is necessary to do a great deal of blacksmith repair work to moorings of buoys, etc., at the depot during the closed season of navigation, and this work must now be done in the open part of the buoy shed under very severe weather conditions during the winter or at times delayed until the severe storms are over.

Storehouse for cement and lime: Owing to the large amount of construction and repair work necessary in this district, a considerable quantity of cement and lime must be kept on hand. A small building for this storage should be provided.

Reconstruction of wharf: The wharf here has undergone for many years only such repair as necessary to render it serviceable. It is an old wooden structure on cast-iron columns standing on piles cut off about a foot below water level. It should be rebuilt and extended out to the pier line to give additional capacity. Detailed estimate:

Addition to lamp shop.....	\$10,000
Cement and lime storage.....	2,400
Reconstruction of wharf.....	40,600
Total.....	53,000

No. 4. *Hawaiian Islands lighthouse depot.*—For construction and equipment of a lighthouse depot for the nineteenth lighthouse district, \$90,000; and the Secretary

of War is hereby authorized to transfer to the Department of Commerce a portion of the Government property on Sand Island, in the Harbor of Honolulu, to be used as a site for additional facilities for said depot.

**NOTE.**—The act of August 28, 1916 (39 Stat., 538), authorized this work, but no appropriation was made therefor. The greatest need in this district is an adequate lighthouse depot. At present the stores are kept in two small, overcrowded, leaky storerooms on the Channel Wharf, Honolulu, where they are in danger of fire on account of proximity to fishing sampans, which are careless in the handling of gasoline. The heavy stores are kept in a large room adjoining the storage rooms occupied as a depot on Channel Wharf, lately vacated by the Territory because of the condemnation of the wharf. Buoys are kept some on Channel Wharf and some on War Department Wharf No. 1. The heavier buoys can not be kept on the Channel Wharf on account of its dilapidated condition, and when placed on the dock are exposed to the weather, and are frequently covered with coal when warships are coaling. In assembling materials for any construction work it has been the custom to collect them at the Channel Wharf, and if there is any considerable amount that wharf becomes filled up, necessitating the removal of the material on account of inconvenience to other users. Hence, the lack of a depot results in much inefficiency in collecting materials as well as inconvenience and annoyance. The fact that the temporary wharf and storerooms are in a bad state of repair, having been condemned some years ago, makes the situation very uncertain and unsatisfactory. Application for the transfer of Naval Wharf No. 3 and of a piece of land (1.2 acres) contiguous to this wharf was made to the Navy Department, but of this property only the wharf and not the land could be spared by the Navy.

As it has not been possible to acquire any land from the Navy Department adjoining Wharf No. 3, and as the act of August 28, 1916, requires that Government property under control of the Navy be utilized for this depot, recommendation is made herein for a transfer from the War Department of a portion of the Government property on Sand Island, to be used as a site for additional facilities for the proposed depot.

It is proposed to erect adequate buildings and improvements on this site for lighthouse depot purposes. Detailed estimate:

Improvements and enlargement of wharf.....	\$33,550
General storeroom.....	27,000
Buoy wharf, Sand Island.....	9,000
Oil house.....	1,500
Buoy repair and carpenter shop sheds.....	3,250
Improvement of grounds, including walks, fences, etc.....	7,000
Machine and blacksmith shop.....	7,200
Shop equipment, etc.....	3,000
Keeper's dwelling.....	4,500
<b>Total.....</b>	<b>90,000</b>

**No. 5. Light-keepers' dwellings.**—For light-keepers' dwellings and appurtenant structures, including sites therefor, within the limit of cost fixed by act approved February 26, 1907, \$75,000.

**NOTE.**—The act of August 28, 1916 (39 Stat., 537), authorized this work, but no appropriation was made therefor. The appropriations made March 4, 1907 (34 Stat., 1319), and May 27, 1908 (35 Stat., 334), of \$75,000 each, are now exhausted, but dwellings at a number of stations are yet needed, among which may be stated: Amelia Island, Fla.; Ano Nuevo Island, Cal.; Buffalo Breakwater, N. Y.; Charlotte, N. Y.; Diamond Head, Hawaii; Dry Tortugas, Fla.; Frankfort, Mich.; Ludington Breakwater, Mich.; Oswego Breakwater, N. Y.; Piedras Blancas, Cal.; Point Hueneme, Cal.; Point Montara, Cal.; Point Sur, Cal.; Port Eads, La.; Port San Juan, P. R.; Poverty Island, Mich.; Robinson Point, Wash.; Sand Island, Ala.; Tawas, Mich.; Toledo Harbor, Ohio; Two Harbors, Minn.; Cove Point, Md.; Point Lookout, Md.; Bodie Island, N. C.; Point Jiguero, P. R. Detailed estimate:

16 dwellings, at \$4,500.....	\$72,000
Contingencies.....	3,000
<b>Total.....</b>	<b>75,000</b>

**No. 6. Sand Island Light Station, Ala.**—For improving Sand Island Light Station, Ala., \$45,000.

**NOTE.**—In October, 1906, a storm destroyed the dwelling at this station, and since that time the keepers have used the tower as a dwelling. These quarters are not suitable, and it is recommended that a dwelling be erected. There is great need for a fog signal at this station, which at present has none. Fog prevails for a large portion of the winter and spring seasons, making the entrance to Mobile Bay difficult and dangerous at times. It is recommended that the station be equipped with modern fog-signal apparatus. The brick tower, which was originally erected on Sand Island, now stands surrounded by an artificial island of rock, the sand island having washed away. The station was again severely damaged by the hurricanes of 1915 and 1916 and the need of these improvements is urgent. The quantity of rock protection around the tower should be increased, about 3,000 tons of rock being required. Detailed estimate:

Riprap.....	\$26,000
Dwelling for three keepers.....	8,000
Fog-signal building.....	3,000
Fog-signal apparatus.....	8,000
<b>Total.....</b>	<b>45,000</b>

**No. 7. Gulf coast, La., light vessel.**—For constructing and equipping a light vessel for the Gulf of Mexico coast, La., or for general service, \$160,000.

**NOTE.**—The act of October 22, 1913 (38 Stat., 224), appropriated funds for a light vessel for Southwest Pass, but did not provide for South Pass, where there is urgent need for a similar vessel, as both passes are open and used. In the fiscal year 1917 the total value of imports and exports of the port of New Orleans was over \$400,000,000. It is proposed to construct a steel self-propelling vessel equipped with modern light and fog-signal apparatus, similar to that authorized for Southwest Pass. This is an important station, for which a lighted buoy, dependent upon weather conditions for functioning effectively, is inadequate.

**No. 8. Spectacle Reef Light Station, Mich.**—For improving Spectacle Reef Light Station, Mich., \$28,000.

NOTE.—The wall surrounding the tower and supporting the fog-signal building and boathouse is disintegrating at the water line and should be repaired before further damage occurs. It is proposed to place a belt of steel flashing around the entire pier, commencing about 4 feet below the water line and extending about 3 feet above, fastening the same by heavy expansion bolts and back filling the voids with concrete after placing the plate. The station has been carefully inspected from time to time, and the latest examinations indicate very rapid deterioration and undermining of the concrete work, and an appropriation is urgently recommended. Detailed estimate:

Steelwork in place.....	\$16, 300
Concrete backing.....	11, 700
<b>Total.....</b>	<b>28, 000</b>

**No. 9. Depot for fifth lighthouse district.**—For enlarging and improving the lighthouse depot at Portsmouth, Va., in the fifth lighthouse district, or for establishing a new depot, and equipping the same so far as funds may permit, \$275,000.

NOTE.—The present lighthouse depot at Portsmouth, Va., is entirely inadequate to the needs of the fifth district, both in area and in water front. This is the principal depot of one of the largest lighthouse districts and is the headquarters for five tenders and two light vessels during the greater part of the year. The aggregate length of these vessels is over 1,000 feet; the total wharf frontage is only 445 feet, of which over 200 feet is in a narrow slip available for small light-draft vessels only. The operation of tenders is much hampered by this limited frontage, the delay caused by waiting to discharge or receive cargo being estimated to cost the Lighthouse Service not less than \$25,000 a year; and now that the tenders are under the jurisdiction of the Navy Department, increased facilities are an urgent military necessity. The very small area available for buoy storage necessitates much otherwise unnecessary handling of heavy buoys and appendages at large cost of time and money. The available wharf frontage of this depot should be doubled, and the area increased by from 4 to 6 acres. This may be done by purchase of a new and larger site, or by purchase of adjacent property. The present buildings are mainly antiquated wooden structures. They constitute a fire menace and should be replaced by modern fireproof buildings. Detailed estimate:

Purchase of water-front property.....	\$125, 000
Construction of wharf.....	53, 700
Filling, grading, and paving.....	41 250
Storehouse, coal shed, machine, blacksmith, and carpenter shops.....	32 000
Water mains, fire-protection system, and traveling electric crane.....	5, 900
Lighting system and generating plant.....	5, 150
Buoy skids and chain platform.....	4, 000
Miscellaneous equipment.....	5, 000
<b>Total.....</b>	<b>275, 000</b>

**No. 10. Tender for third lighthouse district.**—For constructing, or purchasing, and equipping a lighthouse tender to replace the tender *John Rodgers*, worn out in service in the third lighthouse district, or in the Lighthouse Service generally, \$200,000.

NOTE.—There are three tenders in the third district that are old and of obsolete types, and should be replaced as soon as practicable by modern efficient vessels. These are the *Gardenia*, *John Rodgers*, and *Mistake*. All of these tenders to be kept in commission require repairs that are not warranted by their age and the service obtained from them. Appropriation was made in the act of June 12, 1917, for one tender for the third district, to replace the tender *Gardenia*, but this should be followed by other tenders as rapidly as funds become available. The tender *John Rodgers* is an old side-wheel steamer built in 1883 and will soon need extensive repairs, including a new boiler, and is not worth the expense. Even if the tender were in first-class condition, it would not be an efficient lighthouse tender, as this type of vessel can not be of much, if any, service in any very strong windy or rough weather or in the winter season when ice is encountered; and it is during such weather and conditions that the services of the lighthouse tenders are most needed, this being the time when trouble is encountered in maintaining buoys and other aids to navigation. Also, side-wheel vessels are difficult to handle unless under headway and are, therefore, inadaptable to lighthouse work, which requires them to be frequently worked in narrow and rocky places, in the establishment of buoys, etc. At present the tender force in the third district is taxed to the maximum, and unless a new tender is provided the Service will be seriously handicapped, for the *John Rodgers* can not be economically retained in service much longer. Another disadvantage of this tender is that it can not, owing to its insufficient size and power, handle many of the larger buoys now in use. The need of additional tenders is emphasized at the present time on account of the duty being performed for the military and naval services under national emergency. It should be replaced by a new tender before the end of the year 1918.

**No. 11. Tender for fifth lighthouse district.**—For constructing, or purchasing, and equipping a lighthouse tender to replace the tender *Jessamine*, worn out in service in the fifth lighthouse district, or in the Lighthouse Service generally, \$200,000.

NOTE.—The remarks in the item next above apply also to the tenders *Jessamine* and *Holly*, in the fifth district. These are old side-wheel steamers which should be replaced by modern efficient vessels as soon as practicable. The tender *Jessamine* is at present in need of repairs, at an expense not warranted by the age and general condition of the tender, and should be laid up and condemned before a general breakdown occurs.

**No. 12. Ambrose Channel, N. Y., lighted buoys.**—For improving the system of lighted buoys in Ambrose Channel, N. Y., \$26,000.

NOTE.—The lighting of Ambrose Channel can be improved by the use of acetylene buoys in place of the oil-gas buoys now in use. The marking of this channel was closely connected with the project for erecting Staten Island and West Bank Light Stations, N. Y., for which appropriation of \$100,000 was made in the acts of June 30, 1906 (34 Stat., 710), and March 4, 1909 (35 Stat., 971). There remains a balance of \$26,027.36 from this appropriation, which can be turned into the surplus fund, no additional outlay of funds being required to accomplish this project.

No. 13. *Joe Flogger Shoal, N. J. and Del., aids to navigation.*—For establishing gas buoys and improving the aids to navigation in the vicinity of Joe Flogger Shoal, Del., \$40,000.

NOTE.—The act of June 20, 1906 (34 Stat., 322), authorized \$75,000 for establishing a light and fog signal at or near this shoal. The act of June 30, 1906 (34 Stat., 659), appropriated \$40,000 for this purpose, and the act June 17, 1910 (36 Stat., 535), increased the limit of cost to \$105,000, but no further appropriation has been made. In view of the fact that no safe foundation could be obtained for a lighthouse in this vicinity, authorized by the act of June 20, 1906, it is thought that instead of erecting such a structure it would be better to mark this shoal by modern acetylene buoys along its entire length. The placing of gas buoys at three positions along the shoal has been authorized, but owing to lack of funds to purchase efficient gas buoys and shortage of any other equipment the shoal is poorly marked at present by only two gas buoys of an old type that is not well suited for the purpose. Modern buoys would mark this shoal in the best manner possible. Four gas buoys should be installed on the shoal, and spare gas buoys, moorings, lanterns, etc., should be provided. The Ben Davis Point Shoal Gas and Bell Buoy, 16, is an additional aid in marking the channel past Joe Flogger Shoal, and there is no spare buoy for that station. One should be provided. Standard can and nun buoys should be used in case ice makes it necessary to remove the gas buoys. If the appropriation herein recommended is made, the unexpended balance (\$39,396.79) of the appropriation of June 30, 1906, can be turned into the surplus fund, thus requiring practically no additional outlay of funds. Detailed estimate:

8 gas and bell buoys.....	\$24,000
10 can and nun buoys.....	2,500
Sinkers and moorings for buoys.....	4,700
Extra lanterns and tanks.....	8,800
<b>Total.....</b>	<b>40,000</b>

No. 14. *St. Marys River, Mich., aids to navigation.*—For improving and repairing existing aids to navigation and for establishing and moving aids as required to best serve the needs of navigation in the St. Marys River, Mich., \$80,000.

NOTE.—To properly mark the main channel through the St. Marys River between Detour and Point Iroquois, lights are maintained on some 71 distinct structures, exclusive of floating aids. Forty-five of these structures are on submarine sites, completely surrounded by water and subject to great damage by ice action at the opening of navigation each season. During the past two seasons six structures have been completely destroyed by the ice and two more so badly damaged as to require complete reconstruction. In addition, many more have been damaged to so great an extent as to make a large expenditure necessary for their proper repair. These latter structures are in such condition as to make their complete destruction probable unless repairs are made at a very early date. This work of reconstruction and repair should be undertaken at once, and in addition there are numerous improvements to aids in this locality that will materially add to their effectiveness and in many cases result in a considerable saving in maintenance cost that should be carried out at the same time that general repairs, etc., are made. This is one of the most important sections of the Great Lakes waterway, and it is essential that the aids to navigation be maintained in the highest possible state of efficiency. Estimate of cost:

Repairs to foundations of existing structures.....	\$33,500
Repairs and renewals to superstructures of existing structures.....	10,400
New buoys.....	7,500
New establishments and relocation of existing aids.....	10,700
Improvements to illuminating apparatus.....	17,900
<b>Total.....</b>	<b>80,000</b>

No. 15. *Staten Island Lighthouse Depot, N. Y.*—For extending and enlarging the machine shop at the general lighthouse depot, Tompkinsville, Staten Island, N. Y., \$30,000.

NOTE.—The present machine shop is so constructed as to be unadaptable for the work to be done in it. It will have to be extended and enlarged before it can be made an efficient and economical shop. The interior is divided into small narrow rooms, one story high, so that it is impossible to install any large machinery or a traveling crane, making it necessary to handle all work by hand. The windows are small and so arranged that the shop is dark in practically all parts except close to them. Moreover, the general construction is such that it is almost impracticable and very uneconomical to rearrange the old shop so as to be in any way convenient or efficient. The proposed improvements include an extension on the west side, three stories high, with windows properly located, having a large open room without partitions, the center of the second floor to be omitted to permit installation of traveling cranes for handling all heavy machinery, and the first floor to be so arranged that heavy machinery can be installed in such positions as to be accessible to the cranes. With this extension completed, the old shop can be used as a storehouse for castings, metals, etc., which are used in connection with the machine-shop work, these being now stored in a separate building, which is an inconvenient and uneconomical arrangement. This will also release storage space for other supplies, which is badly needed. Detailed estimate:

Alterations to present shop.....	\$4,000
New addition.....	26,000
<b>Total.....</b>	<b>30,000</b>

No. 16. *Gas buoys, fifth lighthouse district.*—For the purchase of additional gas buoys for the improvement of aids to navigation in the fifth lighthouse district, \$65,000.

NOTE.—A number of deserving projects for the establishment of additional gas buoys should be provided for. Some of these have already received tentative approval, but funds have not been available for their establishment. Several of the proposed buoys have reference to river and harbor improvements already under way or provided for in the rivers and harbors bill. The great naval activity in Chesapeake Bay and tributaries increases the urgency of these projects. Detailed estimate:

Thimble Shoal Channel, Va., buoys.....	\$14,400
Beaufort Entrance, N. C.....	5,200
Tail of Horseshoe, Va.....	5,200
Blue Channel, Thimble Shoal, Va.....	8,800

Cape Lookout Breakwater, N. C.	\$5,200
Elizabeth River, Va.	3,800
Thirty-five Foot Channel, Va.	5,200
Spring Garden Channel, Md.	5,000
Relief buoys	14,000
Moorings	2,000
<b>Total</b>	<b>65,000</b>

No. 17. *Tender for fifth lighthouse district*.—For constructing, or purchasing, and equipping a lighthouse tender to replace the tender *Holly*, worn out in service in the fifth lighthouse district, or in the Lighthouse Service generally, \$200,000.

NOTE.—The *Holly* is a side-wheel steamer built in 1881, and has outlived its usefulness and should be replaced as soon as funds permit. (See also note under item No. 11.)

No. 18. *Virgin Islands, West Indies, aids to navigation*.—For establishing and improving aids to navigation in the Virgin Islands of the United States, West Indies, and adjacent waters, \$50,000.

NOTE.—By Executive order of July 20, 1917, the lighthouse service in the Virgin Islands, West Indies, acquired by the United States by treaty from Denmark, was transferred to and placed under the jurisdiction of the United States Lighthouse Service. The aids to navigation in these islands are not extensive and will require additions and improvements to make the waters safe and to provide for increasing commerce. It is proposed to provide four unwatched gas lights, five new buoys, as well as additional aids as may be necessary after further study and developments, and to place existing lighthouse property in a good condition of repair. Detailed estimate:

4 unwatched lights	\$20,000
5 buoys with moorings	5,000
Relief and spare equipment for lights and buoys	5,000
Repairs to existing property	10,000
Additional aids to navigation, as necessary	10,000

**Total**..... 50,000

No. 19. *Staten Island Lighthouse Depot, N. Y.*—For improving and extending the wharves at the general lighthouse depot, Tompkinsville, Staten Island, N. Y., \$120,000.

NOTE.—The wharves at the general lighthouse depot are in a very poor condition and need extensive repairs. The traffic over the wharves is heavy, and it is necessary to be continually making temporary repairs. To continue the use of the wharves by means of temporary repairs will be expensive. It is advisable to repair and rebuild the wharves as soon as practicable. The present wharf space is limited and the wharves should be extended. There are 21 vessels in the third district (7 tenders and 14 light vessels) which use the general depot wharves, besides a considerable use by vessels of the Navy Department and commercial ships. Detailed estimates:

New wharf	\$65,000
Repairing and rebuilding old wharves	55,000

**Total**..... 120,000

No. 20. *Potomac River, Md., aids to navigation*.—For improving the aids to navigation and establishing new aids on the Potomac River, Md., \$95,000.

NOTE.—The Potomac River, from Maryland Point to Washington, about 40 nautical miles, is now lighted only by 4 gas buoys, 5 minor lights, and 1 lighthouse. The gas buoys are of low candlepower and are of necessity removed from station for several months in winter on account of ice conditions. The minor lights are all fixed white or red lights of low candlepower, located on wharves or on timber structures, which are liable to destruction by ice in winter. Jones Point Light Station is of little use on account of changes in shore line at this point. It is proposed to establish 8 sets of flashing acetylene range lights and 7 or more flashing acetylene single lights, and to replace 15 of the present spar buoys by tall nun buoys more readily picked up at night. Jones Point Light Station and the 5 minor lights above mentioned may then be discontinued. Detailed estimate:

Purchase of sites for 8 lights	\$12,000
Towers for 8 lights on land, including foundation	8,800
Concrete structures for 6 lights on marine sites	28,200
Structures for 9 lights on land	6,800
Illuminating apparatus for 23 lights	32,700
Fifteen tall-type buoys and moorings	7,000

**Total**..... 95,000

Total group No. 1, authorized by law, \$317,000; not yet authorized, \$1,614,000; total, \$1,931,000.

#### GROUP NO. 2.

Works considered essential for the needs of navigation and the equipment of the Lighthouse Service, and which it is recommended be undertaken as resources permit, are submitted with estimates of cost. (These items have been selected from a much larger number of recommendations submitted by the inspectors of the lighthouse districts and others.)

**No. 21. Charleston, S. C., Lighthouse Depot.**—For completing the lighthouse depot at Charleston, S. C., and for constructing an administration building for the sixth lighthouse district, \$75,000.

**NOTE.**—The act of October 22, 1913 (38 Stat., 244), appropriated \$125,000 toward the purchase of a site and construction of a wharf and buildings and equipment, so far as funds might permit, for a depot for the sixth district. This entire appropriation has been expended, but all the necessary facilities have not been provided. The site itself cost \$60,000 and the wharf \$46,418. Further requirements to complete the depot include dwellings for keeper and assistant keeper, who are required to live on the reservation, additional filling, water and sewer systems, walks, roads, oil house, blacksmith shop, additional equipment, etc. Without the completion of this project the district organization is inadequately equipped to efficiently perform its duties.

An office or administration building is needed at the site of the new depot, where necessary land is available. The sixth district office now occupies the "Old Exchange" building in Charleston, which, pursuant to act of Congress approved March 4, 1913 (37 Stat., 899), was on April 30, 1917, deeded by the Secretary of the Treasury to the Order of the Daughters of the American Revolution. The Government does not, therefore, own the building, but it is being occupied by the inspector's office under authority of the statute cited, providing for such occupancy until other suitable quarters are provided. More than half of the building has been vacated by the Lighthouse Service, and it is essential that other suitable quarters be provided for proper administration work of the district.

The logical location for such a building is at the depot site, which is the center of district activities. Detailed estimate:

Administration building.....	\$30,000
Two keepers' dwellings.....	9,000
Oil house.....	5,650
Blacksmith shop.....	2,700
Concrete buoy storage.....	4,800
Walks, roads, grading, water and sewer system, etc.....	11,500
Equipment and fire protection.....	11,350
<b>Total.....</b>	<b>75,000</b>

**No. 22. Depot for seventh lighthouse district.**—For purchasing a site for and constructing and equipping a lighthouse depot for the seventh lighthouse district, \$175,000.

**NOTE.**—The Lighthouse Service storehouse, wooden smithy, and wharf are on property belonging to the Treasury Department. The wooden storehouse and wharf, which are highly inflammable, are located between the Navy coal sheds and piers A and B, one of each on each side, and are, therefore, in an unusually dirty location. The coal dust is practically always in motion, and when the coal conveyors are in operation it blows about in clouds. It finds its way into the depot keeper's quarters and into the storehouse, where thousands of dollars' worth of property is stored, which it is impossible to keep clean. These coal sheds have been erected since the storehouse was built. Furthermore, there are frequently several Navy torpedo-boat destroyers lying alongside at the Navy piers on each side of the depot wharf, which in addition to causing a great deal of dirt are a menace to the lighthouse tenders on account of collision. A new site and wharf are now urgently needed for the efficient and economical work of the district.

Detailed estimate:	
Purchase of water-front property.....	\$30,000
Construction of wharf, including track.....	21,000
Bulkheading.....	8,000
Water mains.....	280
Service building, keeper's dwelling, storehouse, oil house, machine shop, carpenter shop, and blacksmith shop.....	50,040
Boundary fence, buoy skids, and chain platform.....	2,700
Shop equipment.....	3,000
<b>Total.....</b>	<b>175,000</b>

**No. 23. Depot for eighth lighthouse district.**—For constructing and equipping a lighthouse depot for the eighth lighthouse district, at New Orleans, La., or vicinity, \$105,000.

**NOTE.**—A lighthouse depot at New Orleans, La., is of great importance for the convenient and economical administration of the district. It should be at district headquarters, where supplies and materials are readily available and where shipments by rail and steamer could be received and accumulated for distribution by tender or other means at the proper time. The lamp shop should be located at this depot, as at present all intercourse with the mechanic in charge is by mail and telegraph, which is an inefficient method and the cause of numerous delays, and the present quarters are crowded, inadequate, and badly located. The stock and stores, excluding buoys and appendages, should be under the eye of the inspector at all times. The present depot at Port Eads, La., at the South Pass of the Mississippi River, is nearly 100 miles from district headquarters. The act of June 17, 1910 (36 Stat., 536), authorized the removal of the depot from Port Eads to New Orleans or vicinity and the purchase of a suitable site and erection of wharf and depot buildings, but no appropriation for the purpose has been made. A desirable site for the proposed depot would be on a portion of the Public Health Service property between State Street and Henry Clay Avenue, on the river front, provided the transfer of the same be authorized by Congress. It is believed that such transfer would not interfere with the marine hospital, and, if authorized, the amount of this estimate might be reduced by \$16,500. Detailed estimate:

Acquisition of site.....	\$16,500
Wharves on creosoted piling.....	60,000
Structural steel depot shed.....	18,000
Lamp shop, blacksmith shop, oil house, and interior finish of buildings.....	10,500
<b>Total.....</b>	<b>105,000</b>



No. 24. *Ludington, Mich., aids to navigation.*—For improving the aids to navigation and establishing new aids at Ludington, Mich., \$43,000.

NOTE.—The present location of the fog-signal station on the end of south pier subjects vessels to danger of striking the breakwater. The commerce of Ludington, which includes important car-ferry lines across Lake Michigan, is as important as any other port on the east shore of Lake Michigan, and as this port is most inadequately lighted now this improvement is considered well warranted. It is proposed to establish a main light on the outer end of the north breakwater, with fog-signal apparatus, consisting of electrically driven air compressor and compressed-air fog signal with oil engine reserve drive, and to discontinue the present steam fog signal in old wooden structure. Quarters for keepers should be erected adjacent to the light, as it is unsafe to cross the harbor during the winter when the ice is broken up by car ferries. Detailed estimate:

Foundation and tower .....	\$7, 440
Fog-signal building .....	5, 330
Illuminating apparatus .....	2, 000
Fog-signal apparatus .....	7, 220
Quarters for three keepers, including site .....	18, 200
Minor lights on north and south pierheads .....	2, 800
Total .....	43, 000

No. 25. *Tampa Bay, Fla., aids to navigation.*—For establishing and improving aids to navigation in Tampa Bay, Fla., \$15,000.

NOTE.—Tampa is an important seaport with a large and growing commerce by sea. Owing to shallow water in Tampa Bay, deep-draft vessels can reach the city from the Gulf only by means of several comparatively narrow dredged cuts. Provision has already been made for lighting all of the important cuts excepting Cut D, for which lights should be provided as soon as practicable, as large vessels must pass through this cut in order to reach Port Tampa. Detailed estimate:

Concrete foundation .....	\$1, 600
Metal-work towers .....	8, 400
Illuminating apparatus .....	5, 000
Total .....	15, 000

No. 26. *Delaware Bay Entrance, aids to navigation.*—For improving the aids to navigation at the entrance to Delaware Bay, \$148,000.

NOTE.—In consequence of the continued erosion of the shore line in the vicinity of Cape Henlopen Light, Del., the early destruction of that light is anticipated, measures taken for the preservation of the shore line having proved unavailing. Every purpose now served by Cape Henlopen Light would be better served by the rebuilding of Harbor of Refuge Light to a height of about 140 feet. The establishment of large gas buoys is also required, one midway between, and in the line connecting Five Fathom Bank Light Vessel and Overfalls Light Vessel, one at the extreme lower and outer end of Hen and Chickens Shoal, and one in approximately the present position of Fifteen Foot Shoal Buoy. With the improvements recommended herein, including a red sector in the new Harbor of Refuge Light to cover Brown Shoal, the ultimate fate of Cape Henlopen Light will have no bearing on the practical needs of navigation in this vicinity. Detailed estimate:

Rebuilding Harbor of Refuge Light Station .....	\$127, 300
3 gas and bell buoys on station .....	12, 000
1 relief gas and bell buoy .....	4, 000
2 extra gas tanks .....	1, 200
2 extra buoy lanterns .....	2, 000
Sinkers and moorings for buoys .....	1, 500
Total .....	148, 000

No. 27. *Goose Island Flats, N. J., Light Station.*—For establishing a light and fog signal at or near Goose Island Flats, N. J., \$140,000.

NOTE.—Vessels navigating the Delaware River are obliged to make a decided turn at this point. A temporary structure, protected by riprap, was carried away by the ice in January, 1910, although the riprap is partially in place and forms a menace to navigation unless properly marked. A buoy is now maintained at this location, but in winter it is impossible to keep it in position on account of the heavy ice. It is proposed to erect a light and fog signal, on a suitable heavy caisson foundation, close to the channel on the easterly side. Detailed estimate:

Foundation in place .....	\$65, 000
Riprap protection for foundation .....	15, 750
Erection of superstructure .....	48, 750
Illuminating apparatus .....	3, 600
Fog-signal apparatus .....	6, 900
Total .....	140, 000

No. 28. *Alaska, lighthouse depot.*—For a lighthouse depot and the necessary equipment, so far as funds may permit, for the sixteenth lighthouse district, \$90,000.

NOTE.—There is no lighthouse depot in Alaska, and the work of the Lighthouse Service is considerably handicapped by the lack of such facilities. Temporary quarters are now rented at \$325 per month, which would be unnecessary if proper facilities were owned by the Government. The work of the Service in Alaska is increasing materially in volume and importance, with corresponding increase in the amount of work to be handled at the depot. Present rented quarters have been outgrown, and adequate accommodations are not available for rental at reasonable figures. It is not intended at this time to erect office quarters, etc., for which further arrangements in other Federal buildings may be made in the future. Detailed estimate:

Preparation and improvement of site.....	\$6,000
Wharf.....	34,500
Warehouse.....	30,000
Other structures.....	15,400
Plant and equipment.....	4,100
<b>Total.....</b>	<b>90,000</b>

No. 29. *California and Nevada, aids to navigation.*—For the establishment of aids to navigation and improvements of existing aids in the eighteenth lighthouse district, California and Nevada, \$30,000.

NOTE.—Petitions have been received from numerous individuals, merchants, and owners and operators of barges and tugs for lighting the channel between Point San Mateo and the mouth of Alviso Slough. This waterway is the natural outlet for nearly all the produce of the extensive Santa Clara Valley, and the annual traffic, which is now reported to be upward of 30,000 tons, will be greatly increased if the channel is properly marked. The deep channel is narrow and winding, and at present there are no aids to assist mariners in keeping off the shoals at night. Much of the traffic must be carried on at night to take advantage of the tides. A petition to the Secretary of Commerce, dated November 16, 1916, asks for various lighted aids in this locality, which are urgently needed and should be established at once. Gas buoys should also be provided at Fort Rose and Point Huchan. The act of August 28, 1916 (39 Stat., 538), authorized aids to navigation on Lake Tahoe, Cal. and Nev., but no appropriation was made therefor, and funds have not been available from the general appropriations of the Lighthouse Service. Lake Tahoe has an area of approximately 200 square miles, is 21 miles long, has a mail route 70 miles long, and a great many passengers are carried on numerous steamers and launches there annually. Detailed estimate:

2 lighted buoys at \$2,600.....	\$5,200
7 lighted buoys at \$1,000.....	7,000
2 lighted buoys at \$4,500.....	9,000
Establishing 14 minor lights.....	6,300
Illuminating apparatus.....	2,500
<b>Total.....</b>	<b>30,000</b>

No. 30. *Goat Island, Cal., Lighthouse Depot.*—For repairs and improvements to Goat Island Lighthouse Depot, near San Francisco, Cal., \$55,000.

NOTE.—This depot occupies a small area gained by cutting down the steep bluff at the southeast point of Goat Island in San Francisco Bay and filling in along the shore line with the material thus secured. This area and that afforded by the present wharf are now inadequate to afford a proper disposition of the property required to be stored there. This is the only depot in the district. An additional area should be filled in with excavated material to afford room for new storehouses and additional room for storing buoys. The present storehouses are merely wooden sheds, old and poorly constructed. The present wharf should be extended to afford room for working two tenders alongside at the same time, and to permit landing and loading supplies without having to shift material already stored on the wharf. The quarters provided for the depot force are old and insanitary in arrangement and location. New quarters for the keeper and assistant keeper of the depot should be provided on higher ground and the site of the present quarters utilized for the needs of the depot proper. Detailed estimate:

Retaining wall and fill.....	\$6,000
Storehouse, reinforced concrete.....	19,000
Wharf, additional, on iron piles.....	14,000
Dwellings.....	16,000
<b>Total.....</b>	<b>55,000</b>

No. 31. *Point Pinos, Cal., Light Station.*—For improving Point Pinos Light Station, Cal., \$35,000.

NOTE.—Improvements to the combined tower and dwelling at this station are required to keep them in a serviceable condition. Fogs are of frequent occurrence at this point, and a first-class compressed-air signal, together with quarters for two additional keepers, are urgently required. Traffic into Monterey Harbor is steadily increasing and a number of large oil-carrying steamers now run regularly to this port where oil is piped from the oil fields in the interior of the State. Numerous requests have been received from shipping interests to establish a first-class fog signal at this point. The Union Oil Co. has lost one steamer at the entrance to this harbor. There is an average of 800 hours of fog per annum at this station. Detailed estimate:

Fog-signal building.....	\$4,300
Fog-signal apparatus.....	9,600
Dwelling for two keepers.....	15,600
Improvements to present station.....	5,500
<b>Total.....</b>	<b>35,000</b>

No. 32. *Michigan Island, Wis., Light Station.*—For establishing and improving aids to navigation at or near Michigan Island, Lake Superior, Wis., \$100,000.

NOTE.—The act approved May 27, 1908 (35 Stat., 332), appropriated \$2,000 to make a survey and estimate the cost and report upon the feasibility and need of establishing a light and fog signal upon Gull Island or the easterly end of Michigan Island, Apostle Group. As a result of this survey, the conclusion has been reached that the eastern end of Michigan Island is the better site. The act of June 17, 1910 (36 Stat., 586), authorized the construction of a light and fog-signal station at Michigan and Gull Islands at a cost not to exceed \$140,000, but no appropriation has been made therefor. A further study indicates that the best plan is to elevate the present light near the westerly end of Michigan Island, add a fog signal, and establish

a nonattended acetylene light on Gull Island. This arrangement would serve as a better guide to vessels passing in either direction. Detailed estimate:

Foundation, main light.....	\$6,000
Dwellings for three keepers.....	17,000
Tower.....	26,000
Minor light.....	9,495
Illuminating apparatus.....	10,000
Fog signal and hoisting apparatus.....	11,550
Fog-signal building, boathouse, and other buildings.....	11,455
Boats, tramway, walks, etc.....	5,500
<b>Total.....</b>	<b>100,000</b>

No. 33. *Kauhola Point, Hawaii, Light Station.*—For improving the light station at Kauhola Point, Hawaii, \$20,000.

NOTE.—Owing to the importance of this station, located near the northern point of the Island of Hawaii, steps have been taken to change the present lens-lantern light to a converted flashing fourth-order lens. To support this lantern and lens and to complete the improvement of this station, a new tower is necessary. A dwelling for the assistant keeper should also be provided. Detailed estimate:

75-foot cast-iron tower in place.....	\$14,750
Foundation piers for tower.....	1,000
Dwelling.....	4,000
Improvement to grounds.....	250
<b>Total.....</b>	<b>20,000</b>

No. 34. *Anacapa Island, Cal., Light Station.*—For establishing a light and fog signal at or near Anacapa Island, Cal., \$115,000.

NOTE.—Practically all coastwise vessels and a large number of those bound for Panama use the Santa Barbara Channel. The desirable course leads close to the eastern end of Anacapa Island, which is now marked by a small beacon light, not sufficiently powerful to be of service in hazy weather. The American Shipmasters' Association has presented a petition for a light and fog signal, indorsed by the San Francisco and Los Angeles chambers of commerce and important shipping interests on the Pacific coast. It is therefore recommended that a light of high candlepower and a first-class fog signal be established at this point as soon as practicable. Detailed estimate:

Light tower.....	\$16,807
Illuminating apparatus.....	6,800
Fog-signal building and apparatus.....	18,100
Two sets double quarters for four keepers.....	33,000
Oil house, outbuildings, etc.....	7,700
Wharf, launch landing, and derrick.....	9,600
Roads, grading, and fencing.....	6,000
Water supply and sewerage system.....	13,000
Launch and station boats.....	4,000
<b>Total.....</b>	<b>115,000</b>

No. 35. *Santa Barbara, Cal., Light Station.*—For improving Santa Barbara Light Station, Cal., \$28,000.

NOTE.—The station is old and the tower is too small to accommodate the revolving lens now installed in it. The tower stands one-eighth of a mile back from the point of the shore line and the light is partly obscured by trees on other properties. A new tower is required to be built farther out on the point. Coastwise vessels bound north keep close inshore to avoid the prevailing northwesterly wind and sea, and a fog signal should be established here with quarters for two additional keepers. An improvement has been made in changing the light from fixed to flashing and an increase of intensity. The fog signal, as well as other improvements, and a new light tower, are necessary to render the aids efficient. Detailed estimate:

Tower, lantern, and fog-signal building.....	\$9,300
Fog-signal apparatus.....	8,100
Additional quarters.....	8,000
Improvements to present station.....	2,600
<b>Total.....</b>	<b>28,000</b>

No. 36. *Cape Spencer, Alaska, Light Station.*—For establishing a light and fog-signal station at or near Cape Spencer, Alaska, \$125,000.

NOTE.—Cape Spencer is at the entrance to Cross Sound and Icy Strait, through which pass all vessels running from Puget Sound ports to Prince William Sound, Seward, Cook Inlet, and Kodiak, excepting only occasional freighters proceeding by the outside route. With the construction of the proposed Alaskan railroad the traffic by way of Cape Spencer will be materially increased. A small unwatched light is now maintained on the cape, but it is believed that a large watched light and fog signal should be provided, especially for vessels returning from the westward, to be used as a landfall, as it is important that they be given all possible assistance, especially in thick weather. Maritime interests have urged the establishment of this aid. Detailed estimate:

Transportation and housing of materials and men.....	\$22,000
Main station structure.....	65,000
Tower superstructure and metal work.....	16,500
Minor structures.....	4,900
Illuminating apparatus.....	9,600
Fog-signal apparatus.....	1,000
<b>Total.....</b>	<b>125,000</b>

No. 37. *Staten Island, N. Y., Lighthouse Depot.*—For construction and equipping a floating drydock at the general lighthouse depot, Tompkinsville, Staten Island, N. Y., \$130,000.

NOTE.—Owing to the great number of vessels in the third lighthouse district (7 tenders and 14 light vessels) and vessels from other districts that come to the general depot for repairs, a dock of this kind is urgently needed and will result in a great saving to the Government. In the present conditions of ship-building and repair work it is very difficult to have repairs to lighthouse vessels done at all. It is proposed to construct a drydock of 2,000 tons capacity. Detailed estimate:

Drydock.....	\$120,000
Dredging.....	2,500
Mooring piling.....	7,500
Total.....	130,000

No. 38. *Portage Lake, Mich., aids to navigation.*—For establishing a light and fog-signal station upon a new site and improving aids to navigation at Portage Lake Ship Canals, Mich., \$100,000.

NOTE.—The War Department intends to remove the breakwater, and it is therefore necessary to rebuild the light and fog signal on a new site. The new light and fog signal should be established on a pier at the outer entrance, where it would be of the best service to vessels making the harbor. The construction of the station proposed will require considerable time to complete, and this project should have consideration for that reason. The harbor pier on which the present pierhead light station and fog-signal house stand, as well as the timber superstructure under the fog-signal house, are rapidly deteriorating, and it is doubtful if these structures can be maintained much longer in a safe condition unless extensive repairs are made to their foundations, which would be unnecessary in the event of the establishment of the proposed new station. Detailed estimate:

Dredging, piling, and cribwork.....	\$16,000
Stone filling and riprap work.....	12,000
Concrete base with metal flashing.....	36,000
Superstructure.....	22,500
Fog signal and lighting equipment.....	13,500
Total.....	100,000

No. 39. *Ram Island, Me., Light.*—For establishing a light on Ram Island, lower Kennebec River, Me., \$3,500.

NOTE.—The need of this light has several times been expressed by petition. Ram Island is about 5½ miles below Bath, Me.; it is a low island in the middle of the river, with a string of half-tide ledges making off on the easterly side. There is a passage on either side, and at some stages of the tide a 5-knot current exists, from which several accidents have occurred. About 300,000 tons of freight and 175,000 passengers are transported past this island annually, not including the many pleasure craft and small boats which frequent the river. It is proposed to establish an acetylene light on or near the easterly side of Ram Island.

Detailed estimate:	
Light structure, including site.....	\$1,900
Illuminating apparatus and installation.....	1,600
Total.....	3,500

No. 40. *Cape Kumukahi, Hawaii, Light.*—For establishing a light at or near Cape Kumukahi, Hawaii, \$22,000.

NOTE.—Cape Kumukahi is the easternmost cape of Hawaii. There is at present no landfall light for vessels bound to Hilo from the Panama Canal or from the southeast. It is a difficult point to round when sailing from Hilo to the south point or vice versa. A light on this point would be a great improvement to the lighting of the islands. The country in this vicinity is barren, undulating lava rock. An acetylene light is recommended, with a focal-plane height of about 150 feet, which would be visible about 20 miles. Landing from seaward at the cape is impossible at most times, and the only practical method of supplying this station would be by railroad from Hilo to Kapoho and then by wagon road 3 miles to the cape, 1½ miles of which would have to be constructed over the rock. Detailed estimate:

Road.....	\$7,100
Tower, including site and right of way.....	10,240
Illuminating apparatus.....	4,640
Total.....	22,000

No. 41. *Henderson Point, Me., Light Station.*—For establishing a light and fog-signal at or near Henderson Point, Piscataqua River, Portsmouth Harbor, Me., \$4,900.

NOTE.—The need of this aid has several times been expressed by petition. It is often very difficult to locate Henderson Point at night and in thick weather; the channel is narrow and there is a strong tide at this point, where the course changes. The commercial statistics for Portsmouth Harbor indicate about 5,600 vessels arriving and departing annually, transporting about 610,000 tons of freight. It is proposed to establish an acetylene light with fog bell. Detailed estimate:

Structure, including site.....	\$2,100
Illuminating and fog-signal apparatus.....	2,800
Total.....	4,900

No. 42. *Port Real, P. R., Light Station.*—For establishing a light station at or near Port Real, P. R., \$40,000.

NOTE.—The lighthouse at Port Ferro, on the south coast of Vieques, or Crab Island, is one of the primary seacoast lights of the Porto Rican system. The light tower and the keepers' dwelling attached to it are built on top of a rocky promontory undermined for some time by the sea, and the whole structure, already dangerously cracked, is in danger of collapsing. It is urgent to rebuild a lighthouse at or near this point, as this is an important aid to the navigation from St. Thomas to Cuba and other West Indian Islands and the Caribbean Sea. A light in this vicinity is necessary for navigation, and it is proposed to dismantle the present Port Ferro Light Station and to erect a new light station at Port Real, about 3 miles westward where the aid will be more useful and on better ground than on its present location at Port Ferro, as Port Real is the most important and the best anchorage around Vieques Island. The present apparatus at Port Ferro is to be used for this new station. Detailed estimate:

Tower and dwellings for two keepers.....	\$30,000
Outbuilding and piping.....	1,500
Purchase of site.....	2,500
Roads and grounds.....	2,500
Contingencies.....	3,500
Total.....	40,000

No. 43. *Nine Mile Point, Mich., Light Station.*—For establishing a light and fog-signal station at or near Nine Mile Point, Mich., \$50,000.

NOTE.—When Forty Mile Point Light Station was established it was placed on the site designated Forty Mile Point on the county-survey charts. Sailing masters expected the station to be placed at Nine Mile Point, near the entrance to the Straits of Mackinac, but which was not so called officially then. While Nine Mile Point is within the visibility of Spectacle Reef and Poe Reef Light Vessel lights, a fog signal would be of especially great service in thick and foggy weather and during seasons when forest fires prevail. Not less than nine strandings occurred here between 1903 and 1909. In the event of establishing this station, Forty Mile Point could be made a minor light. Detailed estimate:

Tower and fog-signal building, including site.....	\$20,100
Illuminating apparatus.....	5,500
Fog-signal apparatus.....	2,000
Dwellings for three keepers.....	12,000
Outbuildings, boathouse, fences, etc.....	2,000
Boats and equipment.....	1,500
Total.....	50,000

No. 44. *Caribbean Sea, aids to navigation.*—For establishing aids to navigation in the Caribbean Sea along routes leading to the Panama Canal, \$75,000.

NOTE.—The need for aids to navigation in the Caribbean Sea has become more urgent with the increase of traffic due to the Panama Canal, and such aids have been requested by the steamship companies using these routes. It is proposed to establish gas and whistling buoys at Farrall Rock (Gorda Bank), Southwest Cay (Serrana Bank), Formigas Bank, and Blower Rock (Pedro Bank), an unwatched acetylene light on the south end of Old Providence Island, another unwatched light at Courtown Cays and a first-class can buoy to mark the north end aboal of Old Providence Island. Detailed estimate:

4 gas and whistling buoys with moorings, etc., on station.....	\$26,000
1 gas and whistling buoys with moorings, etc., relief.....	13,000
1 first-class can tall-type buoy.....	1,000
2 towers in place.....	30,000
Illuminating apparatus.....	5,000
Total.....	75,000

No. 45. *Galveston Jetty Light Station, Tex.*—For improving Galveston Jetty Light Station, Tex., \$8,500.

NOTE.—The appropriation for this station is insufficient for the purchase and installation of a sufficiently powerful fog signal. It is recommended that a compressed-air fog signal be installed as soon as funds permit. Detailed estimate:

Compressors.....	\$5,000
Fog-signal apparatus.....	2,000
Piping and installation.....	1,500
Total.....	8,500

No. 46. *Grays Harbor Light Station, Wash.*—For improving Grays Harbor Light Station, Wash., \$15,000.

NOTE.—The present steam fog-signal plant at this station is located in a frame building. Both the machinery and building are quite old and in poor condition. It is proposed to construct a new fireproof building and install an electrically operated siren as soon as funds permit. Detailed estimate:

Fog-signal building.....	\$6,500
Purchase and installation of apparatus.....	8,500
Total.....	15,000

Total, group No. 2, \$1,747,900 (not included in total of estimates).

## DESCRIPTIONS OF NEW WORKS COMPLETED.

The following are brief technical descriptions of important lighthouse works completed since the end of the fiscal year 1916:

### OIL HOUSES FOR LIGHT STATIONS.

*Purpose.*—Isolated fireproof structures for the storage of kerosene and other inflammable supplies were erected at two light stations, in order to lessen the hazard of fire at such stations. These houses were constructed under allotments made from the balances existing under appropriations of \$10,000 each by the acts of May 27, 1908, March 4, 1909, and June 25, 1910. The unobligated balance of these appropriations is now \$255.10. Details regarding each are shown in the following table:

District.	Station.	Site and structure.	Completed.	Cost.
3d.....	Point Judith, N. Y.....	Concrete house 13 by 15 feet.....	July, 1916	\$521
7th.....	Carysfort Reef, Fla.....	250-gallon steel tank.....	June, 1917	188

### WEST BANK LIGHT STATION, N. Y.

*Purpose.*—To reinforce the foundation of the tower, which was badly broken and deteriorated below low water.

*Site.*—West Bank Light Station is located on the west prolongation of axis of outer section of Ambrose Channel, New York Lower Bay, N. Y. The depth of water at this site is about 22 feet.

*Work accomplished.*—Installed riprap bulkhead around the base of tower and filled in between foundation and breakwater with small stones tightly packed.

*Cost.*—The work was done under allotments made from the appropriation "General expenses, Lighthouse Service." The total cost was \$10,913.07. The work was done during July, 1916.

### OVERFALLS LIGHT VESSEL "NO. 69."

*Purpose.*—To strengthen vessel, the original iron bolt fastenings having corroded away to the extent that vessel was becoming unsafe.

*Work accomplished.*—The work consisted of the removal of the wood sheathing, refastening of hull planking, repairing of the keel plate, and the furnishing and installation of new sheathing metal. There were also built and installed 12 water tanks, and the vessel thoroughly overhauled and repaired throughout.

*Cost.*—The work was commenced in January, 1916, and completed in December, 1916. The total cost was \$23,876.22.

### TENDER "LARKSPUR."

*Purpose.*—To repair, rearrange, and strengthen vessel, also to increase the efficiency of and enable vessel to cope with present day buoy work.

*Work accomplished.*—Installed new boilers, new auxiliary machinery, new main deck, repaired and strengthened hull, installed more powerful derrick and hoisting engine, and rearranged quarters, etc.

*Cost.*—The work was started in September, 1915, and completed in June, 1917. The total cost was \$84,777.93.

**STATEN ISLAND LIGHTHOUSE DEPOT, N. Y. (CARPENTER SHOP).**

*Purpose.*—The building which had previously been used as a carpenter shop was an old building, badly constructed, and a menace in case of fire. It was also poorly adapted to carry on the required carpenter work and was undesirable from every standpoint.

*Site.*—The site is on the southeastern portion of the reservation, adjacent to the depot basin, and so located that the work can be carried on efficiently.

*Structure.*—The structure consists of a rectangular, three-story, reinforced-concrete building with flat slab floors, without beams or girders, supported on piers, the outside piers resting on spread footings. The exterior wall surfaces between piers, except for narrow concrete panels above and below the windows, are filled with glass in steel sash. The stairs are of reinforced concrete, and the building is equipped with a complete plumbing outfit. The roof is of the same construction as the floors, except that it is covered with tar and gravel roofing material. The dimensions of the building are 60 by 121½ feet by approximately 40 feet high.

*Cost.*—The building was constructed under the act of August 1, 1914, appropriating \$23,000. It was constructed under two different contracts with the same contractor. Work was commenced in August, 1915, and completed in January, 1917. The total cost was \$21,855.49.

**DEPOT FOR THE SIXTH LIGHTHOUSE DISTRICT.**

*Purpose.*—To meet the demands for increased facilities for the storage of supplies, handling buoys, to provide adequate docking conveniences for tenders, and to bring the depot into closer touch with the district office.

*Site.*—The depot is situated at the west end of Tradd Street, Charleston, S. C., with a frontage of about 680 feet on the Ashley River. Total area of site about 4.7 acres.

*Structures.*—Consist of a creosoted-timber wharf 511 feet 7 inches by 48 feet; a three-story storehouse 110 feet 6 inches by 91 feet 2 inches, in which are located steel storage racks for supplies; the depot keeper's office, lamp shop, and carpenter shop. Track facilities run through the ground floor to the outer end of the wharf.

At the present time the keeper's dwelling is an old wooden house that was purchased with the site. The site is fenced in on two sides with a high wooden (cypress) fence with reinforced-concrete posts. The front fence, on Tradd Street, is of ornamental brick and wrought-iron construction.

*Cost.*—The depot was constructed under the act of October 22, 1913, appropriating \$125,000. The amount expended to June 30, 1917, was \$125,000.

The work was accomplished by contract and hired labor and occupied for lighthouse purposes August 1, 1916.

**DRY TORTUGAS LIGHT STATION, FLA. (WHARF).**

*Purpose.*—This new wharf was built to replace the old wharf destroyed by storm of July, 1916.

*Site.*—On the eastern side of the lighthouse reservation on Loggerhead Key, Dry Tortugas, Fla.

*Structure.*—This wharf is 140 feet long by 10 feet broad, with landing platform at head of dock 20 feet long by 3 feet broad. Structure consists of 28 wrought-iron piles with cast-iron caps, wooden girders, stringers, and decking; support for landing platform made of angle iron.

*Cost.*—This wharf was built under an allotment of \$2,800 made from the act of September 8, 1916. The work was completed in May, 1917, by hired labor. Total cost of work to June 30, 1917, \$2,631.19.

**RELIEF LIGHT VESSEL "NO. 82."**

*Purpose.*—This light vessel, reported in previous annual reports as being sunk and raised, has been reconstructed throughout to strengthen and make the vessel more seaworthy and increase its efficiency for use as a relief vessel on the Great Lakes.

*Work accomplished.*—The hull thoroughly repaired; main and auxiliary machinery put in efficient condition; new steel deck house, including rearrangement of quarters; pilot house and lantern mast installed, replacing those formerly constructed of wood; new acetylene-gas lighting apparatus of greater power installed; fog-signal apparatus

reconstructed to meet the characteristic of all lake vessels; and new submarine bell installed.

*Cost.*—The work of reconstructing the vessel was started in December, 1915, and completed the latter part of July, 1916, at a total cost of \$44,012.

### AIDS TO NAVIGATION, MANISTIQUE, MICH.

*Purpose.*—On the completion of the east and west breakwaters by the United States Engineers, the aids described below were established for the purpose of guiding an important car-ferry line and other lake commerce to the harbor entrance through the crooked channel at the mouth of Manistique River. The aids were placed in commission as they were completed, the entire system being in service by August 17, 1916.

*Sites.*—Manistique Light Station is located near the outer end of the east breakwater, about 1,800 feet from the inner end, where the switch house is located, which is connected with the light station by an electric cable placed along the top of the breakwater. The keeper's dwelling is located on a lot purchased for the purpose, at the city limits, about 1,200 feet northeast of the inner end of the breakwater. The switch house and dwelling are connected by an electric transmission and control pole line across open shore property recently taken over by the city for park purposes.

West breakwater light is located on the outer end of the west breakwater about 1,400 feet from its inner end.

West pier light is located on the outer end of the timber crib forming the west pier about 350 feet from its inner end.

*Structures.*—Manistique Light and Fog Signal: The subfoundation for this tower consists of a timber crib built by the United States Engineers. It rests on bedrock and supports a concrete superstructure, and this in turn supports a rectangular concrete block, 20 by 25 feet in plan and 6 feet high, forming the immediate foundation for the tower. The top of this block is 10 feet above lake level. The tower is of riveted steel plates and angles, square in plan and pyramidal in shape, three and one-half stories high, and supports a cast-iron deck and an old-style fourth-order vertical bar lantern, whose focal plane is about 40 feet above the top of the block. The main floor is 5½ feet above the block and contains the machinery for the fog signal. Below it and partly within the block is a basement room for storage purposes. Above it the second floor supports the air tanks and the third floor the diaphone and attachments. All floors are of reinforced concrete, and the basement and power room are lined with surfaced cement with air spaces next to the steel plates. The two upper rooms are not lined. The switch house mentioned above is a small, round, steel building with a cement floor and houses the switches and remote control magnetic switches. A transformer (2,200 to 440 volts) is located on a pole alongside the house.

West breakwater light: The subfoundation for the tower is similar to that of the main light station and supports a pyramidal concrete block, 13 by 14 feet in plan at the base and 6 feet high, whose top is 10 feet above lake level. This block supports a standard 25-foot steel skeleton tower and accumulator house. A lens lantern is supported by the tower whose focal plane is about 26 feet above the top of the block.

West pier: The subfoundation for this light is a timber crib built by the United States Engineers. It supports a wooden post provided with pulley blocks and tackle for hoisting a post lantern. A wooden lamp house is located at the foot of the mast.

*Illuminating apparatus.*—Manistique Light and Fog Signal Station: The illuminating apparatus consists of a 300-millimeter lens lantern, showing a fixed red light of 340 candles. The focal plane is 50 feet above lake level, and the light is visible 13 miles in clear weather. The light is furnished by a 200-watt gas-filled tungsten-filament electric lamp with a red screen, and there is a reserve lamp for emergency use in case the main lamp burns out. It is controlled by a push button in the dwelling. The voltage is 110, obtained, from 440 volts, by a transformer in the tower previously noted.

West breakwater: The illuminating apparatus consists of a 300-millimeter lens lantern, showing a flashing white light of 120 candles every three seconds. The focal plane is 36 feet above lake level, and the light is visible 10 miles in clear weather. The light is furnished by a three-fourths foot burner using compressed acetylene gas, which is controlled by a flashing mechanism and sun valve.

West pier light: The illuminating apparatus consists of a type B post lantern, showing a fixed white light of 60 candles. The focal plane is 26 feet above lake level, and the light is visible 10 miles in clear weather. The light is furnished by a double-wick kerosene lamp.

*Fog signal.*—Manistique Light and Fog Signal Station: The fog signal consists of a type F diaphone using compressed air, and the characteristic is a blast of 2 seconds duration followed by a silent interval of 18 seconds. The horn is located about 42 feet



above lake level. The compressing plant consists of a single double-cylinder air compressor of 110 cubic feet capacity at 30 pounds per square inch per minute and driven by a 15-horsepower electric motor operating on an alternating current of 440 volts. The apparatus is controlled by a push button in the dwelling.

*Quarters.*—The quarters for the two keepers who attend these aids consist of a two-story and attic dwelling, one set of quarters being over the other. The building is constructed of hollow tile, with stucco exterior, on a concrete foundation and has an asphalt shingle roof. It is heated by hot water, lighted by electricity, and provided with city water and a sewerage system. The basement contains a general boiler room and coal bin for the heating plant and separate coal bins, vegetable rooms, and cellar spaces for each keeper. Each set of quarters consists of a living room, dining room, kitchen, pantry, three bedrooms, bathroom, closets and lockers and an outside porch. There are separate front entrances for each keeper and a general rear entrance. The attic contains large storage spaces for both keepers.

*Cost.*—These aids were established under the act approved October 22, 1913, appropriating \$20,000. The total cost of the work was \$19,999.96. The steel structures were built in the shops, materials were purchased under informal contracts, and the field work was done by hired labor. The work was commenced in December, 1913, and was completed in August, 1916.

### AIDS TO NAVIGATION, SHEBOYGAN, WIS.

*Purpose.*—Upon the completion of the project for improving the harbor at Sheboygan, Wis., by the United States Engineers, which consisted in the removal of the north pier and the construction of a north breakwater to form a stilling basin at the harbor entrance, it became necessary to rearrange and relocate the lights marking the entrance. The entire system was in commission November 24, 1916.

*Sites.*—Sheboygan Breakwater Light Station is located on the southeast end of the new north breakwater, about 4,000 feet from the inner end, at its junction with the shore, where the power house for the fog signal is located, which is connected with the light station by a line of pipe conveying compressed air to the fog signal and a lead-covered electric cable for conveying the current controlling the characteristic valve of the siren.

Sheboygan south pierhead is located on the outer end of the south pier.

Sheboygan north pierhead is located on the outer end of the stub of the north pier.

*Structures.*—Sheboygan breakwater: The subfoundation for this tower consists of a timber crib built by the United States Engineers. It rests on the lake bottom and is capped by a concrete superstructure supporting a rectangular concrete block, 25 by 30 feet in plan and 6 feet high, forming the foundation. The top of the block is 15 feet above lake level. The tower is of riveted steel plates and angles, circular in plan, conical in shape, and supports a cast-iron deck and fourth-order helical bar lantern, whose focal plane is 45 feet above the top of the block. This tower formerly stood on the old north pier and was moved to its present location, without dismantling, by means of a scow. The power house for the fog signal mentioned above is built of hollow tile, with roughcast stucco finish outside and smooth cement stucco finish inside. It stands on a reinforced-concrete slab supported by the reinforced-concrete walls of a basement, and this in turn is supported by the piles and cribwork of the breakwater. The roof is of wooden framework and asphalt shingles. There are two rooms in the basement and one on the main floor. It is heated by a hot-air furnace and provided with city water and sanitary arrangements.

Sheboygan south pierhead: The subfoundation for this tower consists of the timber crib built by the United States Engineers. It supports within it a reinforced-concrete foundation for the tower consisting of four piers and a slab whose top is 7 feet above lake level. The slab supports a standard 31-foot steel skeleton tower and accumulator house. The focal plane of the lens lantern supported by the tower is about 33 feet above the top of the block.

Sheboygan north pierhead: The foundation for this light consists of the cribwork of the old north pier and supports an iron post from which a post lantern is exhibited.

*Illuminating apparatus.*—Sheboygan breakwater: The illuminating apparatus consists of a fifth-order lens showing a flashing red light of 160 candles every 4 seconds. The focal plane is about 55 feet above lake level, and the light is visible 10 miles in clear weather. The light is furnished by a 1-foot burner using compressed acetylene gas, controlled by a flashing mechanism and a sun valve.

Sheboygan south pier: The illuminating apparatus consists of a 200-millimeter lens lantern showing a flashing white light of 70 candles every 3 seconds. The focal plane is about 40 feet above lake level, and the light is visible 8 miles in clear weather. The

light is furnished by a one-half foot burner using compressed acetylene gas, controlled by a flashing mechanism.

*Sheboygan north pier:* The illuminating apparatus consists of a type B post lantern showing a fixed red light of 20 candles. The focal plane is 31 feet above lake level. The light is furnished by a double-wick kerosene lamp.

*Fog signal.*—*Sheboygan breakwater:* The fog signal consists of a standard 6-inch automatic siren using compressed air, and the characteristic is a blast of 3 seconds duration followed by a silent interval of 27 seconds. The 3½-inch compound whistle valve governing the siren is operated by an electric solenoid supplied with current in the manner mentioned above. The horn is placed in the tower about 44 feet above lake level. The three air tanks are located on the first and second floors and are connected with the power house near the shore end of the breakwater by a pipe line about 4,000 feet long. The compressing plant in the power house consists of an air compressor of 145 cubic feet per minute capacity at 100 pounds per square inch, belt driven by a 25-horsepower electric motor operating on an alternating current of 220 volts. For emergency use an oil-engine-driven air compressor is installed in the same room. For cooling the air and exhausting its moisture a system of cooling pipes, separator tanks, etc., are installed in the basement and on the outside north wall of the power house, and a valve for reducing the air pressure is located at the entry into the pipe line.

*Quarters.*—The quarters for the two keepers who attend these aids consist of a double two-story dwelling, with apartments for three keepers, and are located on shore near the inner end of the north pierhead. It was completed in October, 1911, at a cost of \$6,000, which has not been included in the cost below. The structure is of brick on a concrete foundation, with cedar-shingled roof. It is heated by hot air, lighted by gas, and provided with city water and a sewerage system. Facing the front, the left-hand side of the house contains the keeper's quarters, consisting of one large room in the basement; kitchen, pantry, dining room, and parlor on the first floor; and three bedrooms with closets and a bathroom on the second floor. The right-hand side contains one set of quarters over the other for the assistants. Each assistant has a separate cellar space and a combined kitchen and living room, a pantry, bedroom or sitting room, a bedroom, and a bathroom on one floor.

*Cost.*—The four aids mentioned (omitting the dwelling, which was built from a special appropriation) were relocated and established under allotments made from the appropriation "General expenses, Lighthouse Service," for 1915, 1916, and 1917. The total cost was \$22,633.95. The steelwork, machinery, and material were purchased under informal contracts and the field work carried out by hired labor. The work was started in March, 1915, and completed in November, 1916.

### AIDS TO NAVIGATION, ALASKA.

*Purpose.*—To meet the demands of the increasing commerce and to continue the work of establishing efficient aids to navigation, two acetylene lights and six gas buoys were established at various points in Alaskan waters. Data relative to these lights are shown in the table following.

*Fog signals.*—One gas buoy has a bell sounded by the action of the sea.

*Quarters.*—There are no quarters. These lights are all of the unwatched type, using compressed acetylene in acetone, supplied from batteries of steel cylinders, which contain a sufficient supply of gas to operate the light continuously between visits of the lighthouse tender.

*Cost.*—The appropriation of 1911 has been expended, and to June 30, 1917, the total expenditure from the appropriation of August 1, 1914, was \$59,695.

Name of light.	Locality.	Structure.	Top of lantern above ground, in feet.	Illuminating apparatus.	Characteristic.	Intensity of light, in candles.	Focal plane above mean high water, in feet.	Miles seen.	Approximate cost.	Date of establishment.
Hanlin Rocks.....	Kodiak Harbor.....	Small white wooden house.	10	Acetylene lens lantern.	Group flashing white (flash 0.3 sec., eclipse 0.9 sec.; flash 0.3 sec., eclipse 4.5 sec.).	310	43	11	\$2,885	July 27, 1916
Susitna River.....	Cook Inlet.....	.....do.....	10	.....do.....	Flashing white (flash 0.3 sec., eclipse 2.7 sec.).	130	13	9	451	Aug. 12, 1916
Channel Rock Gas Buoy, 2.	Sitka Sound.....	Type L gas buoy.....	.....	.....do.....	.....do.....	70	12	7	1,490	Feb. 26, 1917
North Rock Shoal Gas Buoy, 2.	Orca Inlet.....	.....do.....	.....	.....do.....	Flashing red (flash 0.3 sec., eclipse 2.7 sec.).	40	12	6	2,706	Aug. 31, 1917
Orca Inlet Gas Buoy, 6.	.....do.....	.....do.....	.....	.....do.....	Flashing white (flash 0.3 sec., eclipse 2.7 sec.).	130	12	9	2,706	Do.
Potter Rock Gas Buoy, HS.	Tongass Narrows.....	.....do.....	.....	.....do.....	Flashing white (flash 0.4 sec., eclipse 1.0 sec.).	70	12	7	2,709	Sept. 21, 1916
Poundstone Rock Gas and Bell Buoy, 1.	Lynn Canal.....	.....do.....	.....	.....do.....	Flashing white (flash 0.3 sec., eclipse 2.7 sec.).	130	12	9	2,886	Oct. 15, 1916
Reef Island Reef Gas Buoy, 2.	Prince William Sound.	.....do.....	.....	.....do.....	Flashing white (flash 1 sec., eclipse 9 sec.).	130	12	9	2,709	Sept. 1, 1916

## CAPE ST. ELIAS LIGHT STATION, ALASKA.

*Purpose.*—To identify Cape St. Elias, an important landfall for mariners navigating the Alaskan coast. All vessels, whether plying between southeastern and southwestern Alaska or bound direct between Prince William Sound and ports of the Pacific Coast States, make Cape St. Elias. The light was established September 6, 1916, and the fog signal went into commission January 30, 1917.

*Site.*—The station is located on the southern end of Kayak Island, which extends 25 miles out into the Pacific Ocean, south of Controller Bay, terminating in a bold promontory known as Cape St. Elias, near which stands Pinnacle Rock. Dangerous reefs extend some 3 miles off the cape. The building, consisting of a combined tower and fog-signal building, storage house, dwelling, and hoist house, stands on the slope westerly from the promontory, and the boathouse and shop are located at the foot of the bluff at the head of the tramway to both east and west beaches. The foundations of all structures are on a hardpan formation, and the tower stands on a terrace whose grade line is about 42½ feet above mean high water.

*Structures.*—The tower is constructed of reinforced concrete. It is square in plan with vertical walls, supports a square cast-iron watch-room gallery with railing and cylindrical watch room, the latter supporting a second-order cylindrical helical bar lantern, whose focal plane is about 42½ feet above grade line. There is a room on the first floor, and above it there is a service room, then the watch room and lantern mentioned above. A clock-weight shaft runs through the center of the tower from a pit in the first floor to the watch-room floor above.

The fog-signal building is connected with the tower at its southwest corner, and is also constructed of reinforced concrete. It contains one room. The concrete floor is provided with covered trenches for oil, water, and exhaust piping and foundation for the machinery. The walls are lined with hollow tile and plastered, and the roof trusses are of steel covered with asbestos slates. The storage building is constructed entirely of reinforced concrete, including the roofs and floors. It projects from the north side of the fog-signal building and is in two sections and on two different levels. The section connected with the fog-signal building contains a coal bin and various apparatus connected with the oil, water, and cooling systems. The other section contains in the lower story two water-storage cisterns, and a filter cistern for the rain water from roofs of fog-signal building and dwelling and in the upper story steel tanks for the fuel oil and kerosene, and storage for gasoline, lubricating oils, etc. The hoist and boat houses are of cement-sand brick manufactured at the site, and the roof trusses are of wood covered with asbestos slates. The hoist house contains two rooms. One contains a 9-horsepower oil engine for pulling the car up the tramway from the boathouse to the storage house, and the other room is for the storage of paints, oils, etc. The boathouse contains one room, in which is located a 6-horsepower oil engine for pulling the car up the tramways from the east and west beaches and storage space for three dories. A carpenter shop is located in one end of the room.

*Illuminating apparatus.*—The illuminating apparatus consists of a third-order flashing lens of two grouped panels, each made up of 7 refracting and 10 upper and 4 lower reflecting prisms, rotating on a mercury float driven by clockwork, and showing two white flashes every 20 seconds. The intensity of the light is estimated at 300,000 candles, the focal plane is 85 feet above mean high water, and the light is visible 15 nautical miles in clear weather. A 55-millimeter 3-mantle, triple-tank, type B, incandescent oil lamp furnishes the light. The kerosene is pumped from the storage building to the service room by a self-measuring oil pump.

*Fog signal.*—This consists of duplicate 6-inch automatic sirens blown by compressed air at 45 pounds pressure per square inch and using double-mouth copper trumpets located 57 feet above mean high water. The characteristic is a double blast every 60 seconds. The compressing plant consists of two 18-horsepower direct-connected, tandem, crude-oil engines and compressors, each having a capacity of 108 cubic feet of free air per minute at 60 pounds pressure. There are two air receivers or tanks, and the supply pipe from the low-pressure tank passes through a preheater to the sirens.

*Quarters.*—The quarters for the keepers in charge of this station consist of a single two-story dwelling constructed of cement-sand brick manufactured at the site, and the roof trusses are of wood covered with asbestos slates. The basement contains three rooms, for the hot water heating plant, coal, and the stores and provisions. The first story contains an entrance hall, kitchen, pantry, dining room, office, and a spare room for visiting employees. The second story contains four bedrooms with closets, hall, and bathroom. In the attic are five tanks for the water supply to dwelling and fog signal, in addition to those in the storage building. Supplies are landed by boat from the tender on either the east or west beaches and thence by shore tramways to the station.

*Cost.*—The station was established under the act approved October 22, 1913, appropriating \$115,000. The amount expended to June 30, 1917, was \$113,653.64. The work was carried out by the purchase of materials and hired labor. The metal work of the upper part of the tower was built under contract. Construction began June 1, 1915, and was virtually completed October 1, 1916.

#### LIGHTHOUSE TENDER "CEDAR."

*Purpose.*—The tender *Cedar* was built for general lighthouse service as a seagoing tender in the waters of Alaska, sixteenth district.

*Structure.*—This tender is 200 feet 8 inches over all, with a molded beam of 36 feet and a displacement of 1,800 tons when floating at a mean draft of 13 feet in salt water. The entire vessel throughout is built of steel, with seven water-tight bulkheads. The hull is constructed with a double bottom throughout for carrying water and fuel oil. Fuel-oil tanks built structurally are also fitted. All deck and pilot houses are of steel. A steel derrick mast, with reinforced wooden boom, complete with steel-wire rope, falls, and blocks, operated by a steam hoisting engine of the four-drum type, is fitted at the after end of the buoy deck. A steam anchor windlass is fitted under the fore-castle deck forward with a capstan above the deck. A steam hoister is also fitted on the upper deck aft of the steel mainmast.

*Machinery.*—The propelling machinery consists of one triple-expansion surface-condensing engine of the vertical inverted type, having cylinders 20, 32½, and 55 inches in diameter by 39 inch stroke, driving a right-handed, four-blade, cast-steel, built-up propeller, 11 feet 6 inches in diameter by 16 feet pitch, and supplied with steam at 190 pounds per square inch by two three-furnace Scotch-type boilers using oil as fuel, having a total heating surface of 4,760 square feet. The tender is fitted throughout with all modern appliances, including sanitary plumbing and fixtures, drainage system, fire main, steam-smothering fire system, hot and cold fresh-water system, oil-burning system operating main boilers and galley range, electric lighting system, and radio apparatus. Foundations have also been provided for four 6-pounder guns.

*Quarters.*—The complement of the tender is 7 officers and 22 men. The deck officers' and radio operator's quarters are located on the upper deck under and aft of the pilot house. The inspector's quarters are located on the upper deck aft. Quarters for the superintendent and engineers are located on the main deck aft, as are also the officers' mess room, galley, storerooms, and five spare staterooms for official passengers. Quarters for 16 men are located forward under the main deck. The cargo holds are located forward under the buoy or main deck, also aft under the main deck. The forward hold is subdivided in way of the main hatch by a vertical water-tight bulkhead, the forward space being a deep hold and the after space divided into an upper and lower hold by a lower deck, all spaces being accessible through the main-deck hatch. The capacity of the cargo holds are: Forward deep hold, No. 1, 15,196 cubic feet; forward upper hold, No. 2, 8,111 cubic feet; forward lower hold, No. 3, 8,210 cubic feet; after hold, No. 4, 8,381 cubic feet.

*Cost.*—This tender was constructed under the act of January 15, 1915, appropriating \$250,000. The vessel was built under contract at Long Beach, Cal., and the cost was \$248,188.88. Construction was commenced May 4, 1915, and the vessel was completed and placed in commission June 30, 1917, at Long Beach, Cal.

#### LIGHTHOUSE TENDER "PALMETTO."

*Purpose.*—The tender *Palmetto* was built for general lighthouse service in the inland waterways, including the rivers, bays, and tributaries of North and South Carolina, Georgia, and Florida, sixth district.

*Structure.*—This tender is 90 feet over all, with a molded beam of 22 feet and a displacement of 170 tons when floating at a mean draft of 4 feet in salt water. It is a single-deck vessel constructed of steel, with deck houses and pilot house of wood. A wooden derrick mast and boom, fitted with steel-wire falls and blocks complete, with a hoister operated by a gasoline engine, are located at the after end of the buoy deck.

*Machinery.*—The propelling machinery consists of two four-cylinder, internal-combustion engines, operating on gasoline, with cylinders 8 inches in diameter by 10-inch stroke. Each engine drives a three-blade bronze propeller 38 inches in diameter by 38-inch pitch. Both propellers turn outboard from the top, the starboard propeller being right handed and the port left handed. The tender is fitted throughout with a sanitary plumbing system, drainage, and compressed-air system operating the flushing, fresh-water, and gasoline tanks, but has no electric lighting system.

*Quarters.*—The complement of the tender is three officers and eight men. The deck officers' and inspector's quarters are located on the upper deck aft of the pilot

house. The officers' mess room, galley, engineer's and assistant engineer's room, crew's quarters, work room, bathrooms, and ice box are located in the main-deck house. The cargo hold is located under the buoy deck forward and has a capacity of 4,972 cubic feet.

*Cost.*—The tender was constructed under the acts of May 27, 1908, and March 4, 1909, appropriating \$200,000 for one tender, and the acts of July 27, 1912, and March 3, 1915, authorizing the use of this amount for the construction of two or more tenders for general service. The vessel was built under contract at Jacksonville, Fla., and the cost was \$27,687.20. Construction was commenced September 3, 1915, and the vessel completed and placed in commission March 19, 1917, at Jacksonville, Fla.

#### LIGHTHOUSE TENDER "ROSE."

*Purpose.*—The tender *Rose* was built for general lighthouse service in the small harbors and inside waters of the coast of Oregon and Washington, seventeenth district.

*Structure.*—This tender is 127 feet 6 inches over all, with a molded beam of 24 feet 6 inches and a displacement of 567 tons when floating at a mean draft of 9 feet 4 inches in salt water. It is a single-deck vessel, constructed of steel throughout with the exception of the upper and forecastle decks and upper-deck houses and pilot house, which are of wood. A wooden derrick mast and boom, complete with hoisting engine and wire-rope gear, are located at the after end of the forecastle deck, the hoisting engine being in the fore hold.

*Machinery.*—The propelling machinery consists of two triple-expansion inverted direct-acting engines having cylinders 8, 13, and 21 inches in diameter with a common stroke of 16 inches, fitted with the Stevenson link-motion reverse gear, each driving a four-blade cast-iron propeller 5 feet 6 inches in diameter by 7 feet 11 inches pitch, the starboard propeller being right handed and the port left handed, the propellers both turning outward from the top. Steam is supplied at a working pressure of 200 pounds per square inch by two Almy water-tube boilers using oil as fuel, having a total heating surface of 3,210 square feet.

The tender is completely fitted throughout with all modern appliances, including sanitary plumbing and fixtures, heating and drainage systems, and electric lighting system.

*Quarters.*—The complement of the tender is 4 officers and 16 men. The officers' quarters are located in the main-deck house aft and the upper-deck house aft of the pilot house. The officers' mess room, galley, storerooms, etc., are located on the main deck, as is also the inspector's and superintendent's staterooms and bathroom. Quarters for the crew are located forward under the forecastle deck. The cargo hold is located under the buoy deck and has a capacity of 5,320 cubic feet.

*Cost.*—This tender was constructed under the acts of May 27, 1908, and March 4, 1909, appropriating \$200,000 for one tender, and the act of July 27, 1912, authorizing the use of this amount for the construction of two tenders for general service. The vessel was built under contract at Seattle, Wash., and the cost was \$92,135. Construction was commenced on November 6, 1914, and the vessel completed and placed in commission August 8, 1916, at Seattle, Wash.

#### LIGHT VESSEL "NO. 101."

*Purpose.*—Light vessel No. 101, on October 4, 1916, was placed on station off Cape Charles, Va., entrance to Chesapeake Bay, in the fifth district.

*Structure.*—The vessel is 101 feet 10 inches over all, with a molded beam of 25 feet and a displacement of 360 tons when floating at a mean draft of 11 feet 4 inches in salt water. The entire vessel is built of steel, including the bulkheads and doors forming the main-deck quarters, the upper deck throughout being of the turtle-back type. A steel pilot house and chart house and a trunk forming a ventilator and light shaft over the engine room are located on the upper deck. One steel lantern mast, of a diameter sufficient to contain a ladder giving access to the lantern, is fitted. Modern devices have been fitted for the stowage of anchors and boats. A small wooden jigger mast and sail, for steadying the vessel at anchor, is fitted on the upper deck aft.

*Illuminating apparatus.*—The signal light is housed in a lantern at the head of the mast. Within the lantern is fitted a clockwork and revolving mechanism supporting and carrying a fourth-order lens, which is constructed with demountable optical panels and color screens for substituting a fixed light for a flashing light or vice versa. The construction will permit of installing an incandescent oil-vapor lamp or an acetylene lamp, as desired. The focal plane of the lens is 50 feet above water. The light at present in use is acetylene gas. The lens is fixed, and the intensity of the light is equal to 1,200 candles.

*Fog signal.*—This apparatus consists of a 6-inch automatic rotating air siren connected to and operated by high-pressure storage tanks supplied by two compressor units, each unit being a two-cylinder air compressor driven by a two-cylinder internal-combustion engine using kerosene oil as fuel, the four-throw crank shaft being common to both engine and compressor, the cylinders all being vertical and mounted on an integral bed-plate forming the crank case. A submarine bell operated by compressed air is also fitted.

*Machinery.*—The propelling machinery consists of one four-cylinder, two-cycle, 200-horsepower Mietz & Weiss kerosene-oil engine of the direct reversible type, having cylinders 14 inches in diameter by 18½ inches stroke, making 225 revolutions per minute, driving a 4-blade, right-handed, cast-iron propeller, 5 feet in diameter by 5 feet 3 inches pitch. The vessel throughout is fitted with all modern appliances, including windlass, sanitary plumbing and fixtures, and drainage, fire, and heating systems, but has no electric lighting system.

*Quarters.*—The complement of the vessel is four officers and seven men. The officers' and crews' quarters, galley, mess rooms, pantry, bathrooms, lamp room, and other miscellaneous storerooms are located on the main deck.

*Painting.*—The hull is red, with "Charles" in large white letters on each side.

*Cost.*—This light vessel was constructed under the act of August 26, 1912, appropriating \$250,000 for light vessels for general service. The vessel was built under contract at Wilmington, Del., and the cost was \$110,065.09. Construction was started March 6, 1915, and the vessel was completed and delivered to the Government on September 25, 1916.

#### LIGHT VESSEL "NO. 102."

*Purpose.*—Light vessel No. 102, on February 24, 1917, was placed on station in the Southwest Pass, entrance to the Mississippi River, La., in the eighth district.

*Structure.*—The vessel is 101 feet 10 inches over all, with a molded beam of 25 feet and a displacement of 360 tons when floating at a mean draft of 11 feet 4 inches in salt water. The entire vessel is built of steel, including the bulkheads and doors forming the main deck quarters, the upper deck throughout being of the turtle-back type. A steel pilot house and chart house and a trunk forming a ventilator and light shaft over the engine room are located on the upper deck. One steel lantern mast, of a diameter sufficient to contain a ladder giving access to the lantern, is fitted. Modern devices have been fitted for the stowage of boats and anchors. A small wooden jigger mast and sail, for steadying the vessel at anchor, is fitted on the upper deck aft.

*Illuminating apparatus.*—The signal light is housed in a lantern at the head of the mast. Within the lantern is fitted a clockwork and revolving mechanism supporting and carrying a fourth-order lens, which is constructed with demountable optical panels and color screens for substituting a fixed light for a flashing light or vice versa. The construction will permit of installing an incandescent oil-vapor light or an acetylene lamp, as desired. The focal plane of the lens is 50 feet above water. The light at present in use is incandescent oil-vapor burned in a mantle, the lens being fitted with flash panels. The intensity of the light is equal to 24,000 candles.

*Fog signal.*—This apparatus consists of a 6-inch automatic rotating air siren connected to and operated by high-pressure storage tanks supplied by two compressor units, each unit being a two-cylinder air compressor driven by a two-cylinder internal-combustion engine using kerosene oil as fuel, the four-throw crank shaft being common to both engine and compressor, the cylinders all being mounted on an integral bedplate forming the crank case, all cylinders being vertical. A submarine bell operated by compressed air is also fitted.

*Machinery.*—The propelling machinery consists of one four-cylinder, two-cycle, 200-horsepower Mietz & Weiss kerosene-oil engine of the direct reversible type, having cylinders 14 inches in diameter by 18½ inches stroke, making 225 revolutions per minute, driving a four-blade, right-handed, cast-iron propeller, 5 feet in diameter by 5 feet 3 inches pitch. The vessel throughout is fitted with all modern appliances, including a power windlass, sanitary plumbing and fixtures, and drainage, fire, and heating systems, but has no electric lighting system.

*Quarters.*—The complement of the vessel is four officers and seven men. The officers' and crew's quarters, galley, mess room, pantry, bathrooms, lamp room, and other miscellaneous storerooms are located on the main deck.

*Painting.*—The hull is red, with "Southwest" in large white letters on each side.

*Cost.*—This light vessel was constructed under the act of August 26, 1912, appropriating \$250,000 for light vessels for general service. The vessel was built under contract at Wilmington, Del., and the cost was \$110,065.09. Construction was started March 6, 1915, and the vessel was completed and delivered to the Government on January 3, 1917.

# SUMMARY OF IMPORTANT CONSTRUCTION AND REPAIR WORK UNDER GENERAL APPROPRIATIONS, COMPLETED DURING FISCAL YEAR 1917.

Station.	Cost.	Character of work.
<b>SECOND DISTRICT.</b>		
Handkerchief Light Vessel No. 3, Mass..	\$4,858	Removing old water tanks, building new deck house, and installing new windlass.
Relief light vessel No. 66, Mass. ....	6,515	Docking, and repairs to complete defaulted contract of Musgrave Machine Co.
Cape Cod Canal Dolphins, Mass. ....	3,871	Placing riprap around dolphins in canal approach, Buzzards Bay.
Race Point Light Station, Mass. ....	4,701	Installing oil engines and compressors in place of steam.
<b>THIRD DISTRICT.</b>		
General depot. ....	1,711	Installed heating system, machinery, motors, electric wiring, and other improvements.
Do. ....	5,189	Repaired fender and bearing piles, stringers, and chocks of wharves.
Great Captain Island Light Station, Conn. ....	2,426	Rearranged and improved dwelling to provide two additional rooms, renewed sidewalk, etc.
Do. ....	1,644	Furnished and installed new illuminating apparatus.
Long Beach Bar Light Station, N. Y. ....	3,897	Furnished and placed 1,660 tons of riprap and reset 160 tons around station.
Mill Rock Northerly Light, N. Y. ....	1,380	Built skeleton steel light tower with tank house, furnished gas tanks and lantern, and placed light in operation.
Watch Hill Light Station, R. I. ....	1,718	Furnished and installed illuminating apparatus.
Tender John Rodgers. ....	1,107	Repairs to boilers and various repairs to hull and machinery.
Tender Lilac. ....	3,851	General repairs.
Tender Mistletoe. ....	1,268	Docked and made general repairs to hull and machinery.
Tender Myrtle. ....	1,785	Docked, repaired sheathing metal, recaulked seams, and other repairs to underwater body.
Relief light vessel No. 16. ....	4,864	General repairs, including two new acetylene lights.
Cornfield Point Light Vessel No. 48. ....	1,389	General repairs.
Fire Island Light Vessel No. 68. ....	1,018	Do.
Relief light vessel No. 78. ....	1,809	Do.
Five Fathom Bank Light Vessel No. 79. ....	5,146	Do.
Ambrose Channel Light Vessel No. 87. ....	1,062	Do.
<b>FOURTH DISTRICT.</b>		
Delaware City Light Station, Del. ....	1,002	Lantern post constructed and acetylene light installed thereon.
Ship John Shoal Light Station, Delaware Bay. ....	2,679	799 tons of riprap deposited around foundation.
Edgemoor Lighthouse Depot, Del. ....	2,018	Harbor dredged.
Christiana North Jetty Light, Del. ....	1,408	Walk constructed to tower.
Tincum Island Range Rear Light Station, N. J. ....	1,440	New lens installed.
<b>FIFTH DISTRICT.</b>		
Lazaretto Lighthouse Depot, Md. ....	4,800	Extended wharf 120 feet.
Long Point Depot Reservation, N. C. ....	1,279	Built reinforced-concrete sea wall.
Fishing Battery Light Station, Md. ....	1,159	Installation of acetylene apparatus.
<b>SIXTH DISTRICT.</b>		
Charleston Lighthouse Depot, S. C. ....	11,608	Separate projects have been taken up during the fiscal year as follows: Alterations to storehouse, track, cinder fill, concrete floor, plumbing, etc., \$3,980; plastering exterior and interior walls, \$1,199; steel shelving for depot stock, \$1,550; constructing Tradd Street brick and iron fence, \$2,750; transferring lamp shop to depot and equipment, \$2,129.
Georgetown Light Station, S. C. ....	9,313	Moving keeper's dwelling from South Island to North Island, \$2,600; rebuilding South Jetty Range Front and Rear and Middle Ground Range Front and Rear Lights, \$3,116; rebuilding assistant keeper's kitchen, grading the grounds, putting in water supply, \$3,597.
Cape Romain Light Station, S. C. ....	4,118	New boathouse and wharf, general repairs to dwellings and grounds.
<b>SEVENTH DISTRICT.</b>		
Cuts C, E, and F Ranges and Cut K Range Rear Lights, Fla. (7 lights). ....	1,301	Installed locomotive headlights in place of lens lanterns.
Cut G Range Lights, Fla. (2 lights). ....	3,030	Established 1 reinforced-concrete 4-pile structure and 1 4-pile wooden structure with 5-day lens lantern.
Hillsboro Bay Range Lights, Fla. ....	3,030	Do.
Hillsboro River Range Lights, Fla. ....	3,030	Do.
Fowey Rocks Light Station, Fla. ....	2,917	Scaled and painted tower, removed wooden lining of stair cylinder, and made general repairs.
Sombrero Key Light Station, Fla. ....	3,999	Scaled and painted tower and dwelling and made general repairs.



## SUMMARY OF IMPORTANT CONSTRUCTION AND REPAIR WORK UNDER GENERAL APPROPRIATIONS, COMPLETED DURING FISCAL YEAR 1917—Continued.

Station.	Cost.	Character of work.
<b>EIGHTH DISTRICT.</b>		
Bastian Bay, Bayou Cook, and Bayou Courant Lights, La.	1,643	Establishment of 1 square 4-pile post-lantern light and 2 single-pile post-lantern lights.
Brazos River Entrance Gas and Whistling Buoy and Brazos River Gas Buoy, 2, Tex.	4,000	Establishment of 1 gas and whistling buoy and 1 gas-lighted buoy.
Caucus Cut Gas and Whistling Buoy, 1A, Fla.	4,715	Establishment of gas and whistling buoy.
Galveston Jetty Light Station, Tex.	1,780	Rebuilding temporary construction wharf at light station, etc.
Do.	1,352	Intermediate T-beams installed on struts of lower and middle sections of substructure.
Houston Channel, Tex.	2,350	Establishment of 39 second-class spar buoys.
Light vessel No. 81 (Heald Bank), Tex.	2,248	Various repairs to boilers, machinery, and hull.
Mobile Entrance Gas and Whistling Buoy, Ala.	4,715	Establishment of gas and whistling buoy.
Mobile Bar Gas Buoys Nos. 1, 2, and 3 and West Bank Gas Buoy No. 5, Ala.	8,000	Establishment of 4 gas-lighted buoys.
Tender Camellia.	2,415	General repairs and overhauling main engine valve motion.
Tender Sunflower.	3,723	Repairs to boilers, machinery, and general repairs to hull.
<b>NINTH DISTRICT.</b>		
Puntilla Point, San Juan Depot, P. R.	998	Riprap for shore protection.
San Juan Depot, P. R.	2,059	The lamp shop was torn down and rebuilt of reinforced concrete.
<b>TENTH DISTRICT.</b>		
Buffalo Depot, N. Y.	1,601	Provided new motor boat, No. 121.
Strawberry Island Lower Cut Range Lights, N. Y.	3,393	Reestablished on new sites, using new skeleton towers; electricity for illuminant in reflector lanterns.
Toledo Harbor Light Station, Ohio.	3,499	Furnished and placed approximately 1,400 tons of riprap stone around foundation.
Buffalo Light Station, and Fair Haven Range, N. Y.	1,898	Provided new launch for each station, Nos. 123 and 124.
Grand Island Range Lights, N. Y.	5,820	Established two acetylene range lights on skeleton steel towers.
Tender Crocus.	5,519	General repairs.
Do.	1,300	Provided new launch, No. 122.
<b>ELEVENTH DISTRICT.</b>		
Split Rock Light Station, Minn.	3,925	Building new tramway and installing gasoline hoisting engine; constructing extension to landing dock.
Passage Island Light Station, Mich.	9,467	Installation of duplicate compressed-air diaphone fog signal in place of steam; installing hot-water heating plant in fog-signal building; extending present dock in concrete.
Keweenaw Harbor of Refuge, Mich.	1,214	Raised dwelling and built concrete basement wall underneath; laid cellar floor of concrete and minor other repairs.
Pilgrim Point Light Station, Mich.	3,585	Rebuilt structure in concrete and provided a complete acetylene lighting equipment.
Devils Island Light Station, Mich.	1,771	Moved old barn and remodeled into second assistant keeper's dwelling; made miscellaneous repairs at the station.
Thunder Bay Island Light Station, Mich.	1,364	Remodeled old fog-signal building into second assistant keeper's dwelling; repaired dock and made miscellaneous repairs to station.
Eagle River Shoals Fog Signal Station, Mich.	6,150	Established new electric siren fog-signal station, complete with quarters for 2 keepers.
Grassy Island North Channel Range Light Station, Mich.	2,572	Rebuilt concrete base for tower; discontinued Ecorse Rear Range, steel tower in its place; built concrete shore protection around dwellings at upper end of range; rebuilt wharves.
Tender Amaranth.	2,001	General repairs.
Light vessel No. 82.	18,943	Reconstructed superstructure and interior work in steel, installed lighting equipment, installed submarine bell, equipped vessel complete, including boats, anchors, etc.; completely overhauled boiler and machinery.
<b>TWELFTH DISTRICT.</b>		
Menominee Pierhead Range, Rear Light, Mich.	1,071	Established locomotive headlight on 60-foot steel tower; repaired elevated walk.
Ludington North Breakwater Light, Mich.	1,196	31-foot steel tower with 200-mm. acetylene light erected on base of old concrete tower.
South Haven Range Rear Light, Mich.	1,119	Established 50-foot steel tower and locomotive headlight.
Tender Sumac.	1,108	Docking; cleaning and painting underwater body; repairs to tail shaft and bearings.
Kenosha Light Station, Wis.	2,265	Repairs to fog-signal building and boathouse; reerecting 1,040 linear feet of metal elevated walk on new concrete superstructure of north pier.

## SUMMARY OF IMPORTANT CONSTRUCTION AND REPAIR WORK UNDER GENERAL APPROPRIATIONS, COMPLETED DURING FISCAL YEAR 1917—Continued.

Station.	Cost.	Character of work.
<b>TWELFTH DISTRICT—continued.</b>		
Racine Reef Light Station, Wis. ....	3,207	Placing 1,000 tons of heavy riprap stone for protection of pier.
Charlevoix South Pierhead Light Station, Mich. ....	1,206	General repairs to keeper's dwelling, station buildings, etc.; stiffening of steel tower on north pierhead.
Eleven-Foot Shoal Light Vessel No. 60, Mich. ....	3,815	General repairs, including new boiler and steam whistle.
Sturgeon Bay Canal Light Station, Wis. ....	2,755	Northwest Entrance No. 3 Light—establishment of 300-mm. acetylene light and equipment on 15-foot steel tower; Northwest Entrance to Cut No. 4 Light—establishment of 200-mm. acetylene light and equipment on 15-foot steel tower.
Sheboygan Breakwater Light Station, Wis. ....	20,573	Moved tower from north pierhead to outer end of north breakwater; established acetylene light, air-siren fog signal in tower and erected fog-signal power house on inner end of breakwater.
Michigan City West Pierhead Light, Ind. ....	1,194	Established 300-mm. acetylene light and equipment.
Tender Hyacinth .....	2,418	General repairs to boiler, propelling machinery, decks, and upper works.
Tender Sumac .....	1,011	Do.
North Manitou Light Vessel No. 56, Mich. ....	6,995	General rebuilding of hull: repairs to decks and upper works, overhauling and repairing fog-signal and propelling machinery.
<b>SIXTEENTH DISTRICT.</b>		
Cape Hinchinbrook Light Station, Alaska. ....	1,181	Concrete footing to wharf, quarters partly replastered, waterproofed main building, and laid new sewer.
Scotch Cap Light Station, Alaska. ....	1,034	Installed diaphone air fog signal, replacing 10-inch air whistle.
Seal Rocks Light, Alaska. ....	1,069	Unwatched acetylene light established.
Tender Fern .....	3,797	Buoy port and apron, minor alterations and general repairs.
Tender Kukui .....	4,401	Machinery replacements and general repairs.
<b>SEVENTEENTH DISTRICT.</b>		
Tongue Point Lighthouse Depot, Oreg. ....	2,192	Repairs to warehouse.
Cape Flattery Light Station, Wash. ....	4,662	Installing water and sewer systems and plumbing in all dwellings; rebuilding hoisting engine house and other repairs.
Do. ....	1,853	A new type G diaphone was installed in place of a first-class air siren.
Destruction Island Light Station, Wash. ....	4,902	General repairs, including new water and sewer systems and plumbing in dwellings.
Ediz Hook Buoy Depot, Wash. ....	1,110	New shed for buoy storage, tramway extended, storage platform extended, and water tank provided.
Mukilteo Light Station, Wash. ....	3,166	General repairs, including concrete-core walls, stone revetment, and the filling and grading of grounds.
Slip Point Light Station, Wash. ....	4,119	General repairs, including plumbing, water system, new outbuildings, and walks.
Semiamoo Harbor Light Station, Wash. ....	5,635	Repairs to substructure.
Slaughters Bar Ranges and Lights, 1 and 3, Columbia River. ....	1,476	Establishment of oil lights on pile substructure.
Tender Heather. ....	4,080	General repairs.
Tender Manzanita. ....	4,502	Do.
Columbia River Light Vessel No. 88. ....	1,879	Do.
Relief light vessel No. 92. ....	1,435	Do.
Swiftsure Bank Light Vessel No. 93. ....	1,206	Do.
<b>EIGHTEENTH DISTRICT.</b>		
Farallon Light Station, Cal. ....	2,928	Changing first-class air siren to a type K diaphone.
Fort Point Light Station, Cal. ....	1,345	Timber bridge 78 feet long across gap from reservation to top of Fort Winfield Scott.
Goat Island Depot and Goat Island Light Station, Cal. ....	2,687	Installation of electric power and lighting system at lighthouse depot; replaced type A, lov, apparatus with electric incandescent light at light station.
Point Conception Light Station, Cal. ....	7,237	Replacing steam fog-signal boilers and 12-inch steam whistle with duplicate gas engines and air compressors operating a type G diaphone.
<b>NINETEENTH DISTRICT.</b>		
Kipahulu Light Station, Hawaii. ....	1,982	Establishment of a 300-mm., high-pressure, automatic acetylene-gas light.
Lahaina Light Station, Hawaii. ....	1,549	Construction of new reinforced-concrete tower on new site and improvements to sea-wall boundary.
Pauwela Point Light Station, Hawaii. ....	1,680	Repairs and improvements to combined light tower and dwelling.



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**REPORT**  
**OF THE**  
**SUPERINTENDENT, U. S. COAST AND GEODETIC**  
**SURVEY**

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# REPORT

OF THE

## SUPERINTENDENT, U. S. COAST AND GEODETIC SURVEY.\*

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DEPARTMENT OF COMMERCE,  
COAST AND GEODETIC SURVEY,  
*Washington, October 5, 1917.*

SIR: There is submitted herewith my annual report as Superintendent of the United States Coast and Geodetic Survey for the fiscal year ended June 30, 1917.

### INTRODUCTION.

In my 1916 annual report consideration was given in detail to the office organization with its various divisions. It showed the functions of these divisions and gave such information as would enable the reader to become acquainted with the office procedure of the Bureau under the reorganization that had been recently put into effect.

That report gave a statement which showed the needs of the Bureau and what had been accomplished in the office and field during the year. The present report is divided into three parts, as follows:

Part I, Chapter I, is devoted to a general discussion of the plan of the field work of the Bureau along the coast and in the interior, what has been accomplished, and what remains to be done. Chapter II considers the needs of the field service in order that its work may be efficiently prosecuted.

Part II, Chapter I, is devoted to a discussion of what has been done at the Washington office of the Bureau, and in Chapter II are taken up some of the needs of the Washington office of the Bureau.

Part III gives a résumé of the work accomplished in the field and in the office during the year.

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\* Fifty-four illustrations appeared in the pamphlet edition of the Superintendent's report, but are omitted from this volume.

## Part I.—FIELD WORK AND NEEDS OF THE FIELD SERVICE.

### CHAPTER I.

#### PLAN OF THE FIELD WORK.

In the language of the organic act creating this Bureau, enacted during the administration of President Jefferson, its purpose was stated to be \* \* \* "to cause a survey to be taken of the coasts of the United States \* \* \* for completing an accurate chart of every part of the coasts within the extent aforesaid." From this origin, as modified and added to by subsequent legislation, the work of the Bureau, as is implied by its present name (*United States Coast and Geodetic Survey*) has been enlarged into what is generally spoken of as two distinct fields of activity. They are surveying of the coasts, generally spoken of as hydrographic surveys which ascertain the depths of our coastal waters, and surveying in the interior called geodetic surveys which consist of the establishment of the control or framework on which all land surveys, Federal, State, municipal, and industrial are or should be based.

#### GENERAL CHARACTER OF THE ATLANTIC COAST.

The nature of the coast largely determines the method of making the hydrographic surveys. Broadly speaking, along the coasts of the United States and throughout their possessions are to be found three general classes of shore formation, each presenting a different problem to the hydrographic surveyor.

From Maine to Sandy Hook, just south of the entrance to New York Harbor, the coastal formation is that of a rocky bluff, or shelving rocks extending to and beneath the waters, strewn with boulders.

From Sandy Hook to as far south as the vicinity of Palm Beach, Fla., the shores are sandy, with an absence of prominent bluffs, rocks, and boulders.

From Palm Beach around the southern shores of Florida, up to the neighborhood of Cedar Keys, coral reefs are characteristic of the coast line. Some of these reefs have taken the form of small islets, known locally as keys, while many others are entirely submerged but reach so close to the surface that they are grave menaces to navigation.

#### THE GULF COAST.

Then, from Cedar Keys to the Mexican boundary line, the coasts are largely sandy, though presenting different characteristics from the sandy stretch between New York Harbor and Palm Beach in that

immense sand bars have been thrown up, in places making great inland bodies or stretches of water through which commerce must travel to reach the Gulf.

#### THE PORTO RICO COAST.

Leaving the shores of the continental United States, there remain long stretches of shore lines touched by the Atlantic Ocean and the Caribbean Sea. They are the coasts of Porto Rico and the outlying islands. Off these shores (with the exception of the north and northwest coasts of Porto Rico which face the open Atlantic Ocean) the depth increases gradually from the shores to the open waters and, as a rule, the bottom is covered with coral growths, and the chief dangers to navigation are the coral reefs as in that stretch of the coast of Florida from Palm Beach around to Cedar Keys. On the north and northwest coasts of the island of Porto Rico the shores are exposed to the open ocean, and the slopes are abrupt; therefore the coral growths along this stretch of the coast, considered from the standpoint of a danger to navigation, are negligible.

#### THE PACIFIC COAST.

Passing now to the Pacific Ocean, the whole of the shores of the United States, from the Mexican boundary to the Canadian boundary, may generally be described as rocky, with stretches of beaches here and there resulting from coastal degradation.

#### THE ALASKA COAST.

The shores of Alaska, from their southernmost point at Dixon Entrance, throughout southeastern, central, and western Alaska, along the northern Pacific Coast side and the Bering Sea side of the Aleutian Islands and back along the Alaska Peninsula to the neighborhood of Bristol Bay, are exceedingly rocky, with stretches of sandy beach here and there. In rapidly reviewing the nature of the coast of Alaska, emphasis must be placed on the precipitous rocky shores of southeastern Alaska, which consist almost entirely of elevated islands and peninsulas carved by glacial action and separated by narrow and deep fiords. Here was found the inspiration for that term "pinnacle rock" which aptly describes the dangerous instrument so well designed by nature to effectually tear a hole in the bottom of a vessel and send her to the bottom.

Passing through these waters the traveler sees on every hand rugged mountain ranges whose profiles present a bewildering confusion of sharp, jagged peaks of various heights. Let him, then, imagine these same topographic features duplicated in the waters about him, the top of the highest peaks appearing above the surface in the form of precipitous rocky islets, those of slightly less elevation rising to within a few feet of the surface, while others, still lower, rise but slightly above the bottom.

With this picture in mind we have some conception of what a problem it is for the hydrographic engineer to discover and chart these hidden dangers rising from the great depth of the ocean



waiting to rip open the bottom of the unfortunate ship that passes their way. To make matters worse, the navigator who can detect other dangers to his vessel with some accuracy is yet groping in the dark with no means of divining the presence of this hidden danger of the sea. There is no break in the water and no ripple on the surface above it. There is absolutely no indication of this concealed menace.

From Bristol Bay to the north and around east to the one hundred and forty-first meridian, the northeastern point of Alaska, the coast line is generally composed of sand beaches and mud flats.

#### THE PACIFIC ISLANDS.

Going now to the islands in the Pacific Ocean we have the coasts of the Hawaiian and Philippine Islands which are surveyed by this Bureau.

The various islands of each of these groups came into existence through volcanic action, and therefore they have abrupt shores which drop off into great depths. The water has a temperature which promotes coral growth where great depths do not occur. There are extensive stretches of these island shores where the coral reefs require the same close surveys that are necessary along the coral coasts of Florida and Porto Rico. This is a general statement which suffices now, but the coasts of the Hawaiian and Philippine Islands will be discussed in detail later on.

Besides these two main groups in the Pacific, there is the little island of Guam, also of volcanic origin, with its shores and coral beds to be surveyed, and on the Atlantic coast the newly acquired Virgin Islands of the United States.

#### THE PANAMA CANAL REGION.

There yet remain, before we have completed a hurried review of the coast lines that fall to the lot of this Bureau to survey, two other areas, one on the Pacific coast and the other on the Atlantic coast. They are the approaches to the Panama Canal. While these are not extensive in area, they are doubtless destined, through the great amount of steamship traffic that will pass through the canal, to become of the utmost importance and will require searching examinations.

As to the character of these two approaches: That on the Atlantic side presents no great problem. There are some coral reefs, where conditions are favorable to their growth, and there are also, here and there, beds of rocks protruding above the sediment from the Chagres River that has in the course of time spread a mantle over the hard bed of the approach to the canal.

That of the Pacific entrance to the canal is a more serious and difficult problem for the hydrographic engineer. Here are found conditions not very different from those of southeastern Alaska, except that the unexpected isolated peaks of rocks found in the ocean bed at the entrance to the canal, and for a considerable distance seaward, had their origin in a volcanic activity, and the conformation of the bed of this approach permits a fairly accurate prediction that dangers may be found.

## EXTENT OF THE GENERAL COAST LINES.

The lineal extent of each kind of coast line included under the classifications according to formation is given below. That a wrong impression may not be conveyed as to the magnitude of the hydrographic area requiring the attention of this Bureau, it is proper to say here that the lineal extent of these shores under these classifications only partly states the situation, for the very patent reason that much depends upon how quickly these shores drop off to great depths free from obstructions to navigation. If the water is comparatively shallow for great distances toward the sea, dotted with islands, a lineal extent of a few miles of shore line embraces great areas to be surveyed, whereas if the shore drops off to great depths free from pinnacle rocks, the area necessary to be covered is small.

The lineal extent of our general coast lines, classified according to formation, is as follows:

**Rocky formation** (generally fixed and unchanged by the action of tides and currents):

	Miles.
From the northern coast boundary of Maine to the entrance to New York Harbor.....	600
The Pacific coast of continental United States.....	1,366
The coast of Alaska from Dixon Entrance to Bristol Bay.....	3,850
The approaches to the Panama Canal.....	71
Porto Rico.....	122
	<hr/> 6,009 <hr/>

**Coral formation:**

From Palm Beach, Fla., around Cedar Keys, Fla.....	567
All of the coasts of Porto Rico except part of the northern and part of the western shores of the main island of Porto Rico.....	189
The coasts of Guam, Hawaii, and the Philippine Islands.....	4,923
	<hr/> 5,679 <hr/>

**Sand or mud flat formation** (subject to change from the action of tides and currents):

From New York Harbor to Palm Beach, Fla.....	1,194
From Cedar Keys around the coast of the Gulf of Mexico to the Mexican boundary.....	1,156
From Bristol Bay around the Alaska coast to the one hundred and forty-first meridian.....	2,790
	<hr/> 5,140 <hr/>

## METHODS OF HYDROGRAPHIC SURVEYING.

It is my purpose to discuss in detail the coast line of each of the coastal States of continental United States, and our other coast lines, both with reference to what has been accomplished and what remains to be done, but if, before doing this, we consider briefly something of the history of the methods of making the hydrographic surveys, I am sure it will lead to a better grasp of the problem that is before us.

Happily for the coordination of surveys made of the coast, whether contiguous or separated by thousands of miles, the original plan

adopted by the Bureau and the one which has been followed throughout its existence, was laid by an eminent scientist who conceived that the survey of the country should be controlled by a connected system of triangulation in order that the position of any selected point in a surveyed area might readily be determined with relation to any other point or points on the surface of the earth which had been previously connected with the triangulation.

With this accurate control, the position of a newly surveyed area can be determined with exactness with relation to completed surveys, and little or no confusion will result.

If the same admirable foresight could have been exercised in planning the means of making surveys as was exercised in coordinating the relation of the positions of the different surveys, then we would have been far more advanced at the present day with less expenditure of energy. Unfortunately, however, there are phases of human activity in which the method of procedure must be learned by practical experience and in which the problem is so intricate that advancement is slow.

This has been the shortcoming, if such it may be termed, of the Bureau in making the hydrographic surveys. Or, better said, human foresight had not the power to conceive the ultimate needs that would arise, because it could not be foreseen what strides marine commerce would make.

An examination of the records of the surveys by the Bureau of any given important harbor where the areas are unchangeable will show that generally at least two different surveys have been made, each adequately meeting the needs of the day when made, and each insufficient for the needs of succeeding eras of ships and shipping.

For example, the deepest draft of merchant vessels ranged from 12 feet in 1825 to 20 feet in 1850. These vessels were sailing ships which, in order to enter any harbor against an adverse wind, must beat back and forth across the harbor. Therefore, they did not require one deep, clearly defined channel so much as the knowledge of the dangerous shoal areas over the entire harbor.

Then, from 1850 to 1895 the draft of the merchant vessels increased from 20 feet to about 30 feet, and most of the commerce was carried in steam-powered vessels that were not dependent on the wind for motive power and could keep to a defined channel.

Now, if we examine these old surveys of the important harbors, we will find that as the draft of the vessels increased there was a seeking out in each harbor of the deepest channel available in the harbor, and of course commerce favored that harbor with the deepest channel. In fact, it is related that in the case of ports less favored with natural channels deep enough to allow a large vessel to pass in and out with a full cargo, the full cargo freight rate was charged before a large vessel would go into such a port for such cargo as she could carry over the bar or shoalest part of the harbor. As this competition sprung up in commerce, resurveys made were not so much of the entire harbors as closer examinations to locate and define these channels.

The draft of merchant vessels has continued to increase until now a depth of 40 feet is required for some of them, and long ago the

natural channels that existed in and to most of the harbors have been either deepened by dredging or abandoned, and entirely new channels dredged.

During this development the methods of making hydrographic surveys have been as follows: During the sailing-ship period, the surveys consisted of a system of widely spaced sounding lines over the entire harbor, with many additional closely spaced soundings at any place on those lines when depths of about 20 feet or less had been found. In other words, the object of the survey was to locate the shoal areas rather than the deep ones. Then, when the commerce was carried in steam vessels that could follow a definite course and which required greater depths, the critical examination with the hand lead line extended not over the entire harbor but along the course of the deep channels, and these examinations show close lines of soundings in finding these channels, but no close examination of the entire area of the harbor.

As indicated above, these hydrographic surveys have been advanced sufficiently to show where the deepest channels are in all the harbors; and, in fact, in the important harbors artificial channels have been dredged, and the acute problem now before the hydrographic engineer is to find, both in the deep channels and the shoaler areas, those obstructions which, consisting of isolated rocks or bowlders, are of such limited extent that they have been missed by all previous surveys made with the lead line.

#### LIMITATIONS OF LEAD-LINE SURVEYS.

It is difficult to explain in words how elusive these dangers are when sought with the hand lead. Even in cases where vessels have struck such rocks, so that their existence is known and their location so closely fixed that the field of search is limited to an area perhaps 100 yards square, it has sometimes taken days of search to find the least water on them. How much more difficult, then—in fact, how utterly impossible it is—to know that in any survey made with the hand lead every danger has been discovered when it is not even known that such dangers exist.

Consider for a moment how surveys with the hand lead are made. The hand lead consists of a line marked in fathoms and feet, to which is attached a piece of lead about 2 inches in diameter and 10 inches long. As the sounding boat moves along on a straight line the leadsman casts the lead ahead of the boat, reading the depth from the line as the lead strikes the bottom and the line becomes vertical. The point where each sounding was taken is accurately located by observers in the boat who, with sextants, measure the angles between known objects on shore.

The sounding lines are closely parallel to one another, the boat moves slowly, and the soundings are taken as rapidly as the depths permit, but even so the area of the space included between any four soundings is comparatively large. Take the case of lines spaced 20 yards apart, with soundings 10 yards apart in each line. This would be considered a close survey, yet the area bounded by two soundings on each of two adjacent lines is 200 square yards, which is ample to contain a bowlder or pinnacle rock 10 yards in diameter and permit it to remain undetected by the soundings.

Finally, when it is remembered that the work must commonly be done in a choppy sea or in currents, so that the boat can not always be kept on the line, and that the lead will strike a steep-sided rock and slide to the bottom undetected, it becomes obvious that it is utterly impossible to think of finding every hidden danger by means of the lead.

In Buzzards Bay, Mass., over an area slightly in excess of 21 square miles, 91,000 soundings had been taken with the hand lead line, and from these soundings a chart had been issued which declared to the world that in this region the mariner might expect to find no less than 31 feet of water. But in this very area the cruiser *Brooklyn* touched a rock that reached up to within 18 feet of the surface, and which had been missed by the hand lead line.

Out of this and like experiences confidence was badly shaken in the reliance to be placed on surveys made with the hand lead line in regions where pinnacle rocks, isolated boulders, and coral reefs rise abruptly from the general contour of the bottom.

#### DEVELOPMENT AND USE OF THE WIRE DRAG.

It was then realized that some more certain method than the lead must be used in such areas. This brought to mind the method of dragging a wire or rope through the water as had been first employed by French engineers and later by the United States Army Engineers. From this beginning the Bureau has developed the modern wire drag which, though simple in conception, has become a wonderful mechanism for rapidly covering extensive areas and yet finding within the area covered every existing pinnacle rock, boulder, or coral reef.

The purpose of the wire-drag survey, then, is to examine areas where dangers in the form of pinnacle rocks, boulders, and coral reefs are suspected to exist, and therefore when the shores, under the classifications as outlined before, are shown to be rocky, or there are coral reefs, the survey must be made with the wire drag to insure finding all dangers. Where the shore is of sandy formation, the wire drag is unnecessary and the lead line survey is sufficient.

However, there is this to be said about both the wire-drag survey and the lead and line survey: Each has its limitations. As the lead and line survey is ineffectual in finding pinnacle rocks and coral reefs, so is the wire drag ineffectual in determining the contour of the bottom beneath the waters surveyed. The horizontal bottom wire of the wire drag when drawn through the water is supported at certain depths by floats on the surface of the water, and thus it will catch on any obstruction coming above the depth to which it is set, but it furnishes no information of the depth of water below the bottom of the drag. This is only learned by making soundings with the lead and line. Therefore, each method must to some extent supplement the other.

#### NEED OF OFFSHORE SOUNDINGS.

Now, while soundings may be made with the hand lead line to a greater depth than 100 to 120 feet, yet this depth is probably the limit of the practical application of this method of making surveys.

It might be thought that as no vessel requires a depth of much over 37 feet, it is unnecessary to sound for depths in excess of 100 to 120 feet. This, however, is not the case, as it is necessary for many purposes to know the depths for great distances from the shores. Take the case of a vessel crossing the Atlantic for an American port. She has met with rough weather, and she is off her course and her position is not known. If she takes no soundings to locate herself until she reaches water that is only 100 to 120 feet deep, she is well-nigh lost. As a matter of fact, vessels with modern devices can sound without stopping in depths up to 100 fathoms, and it is therefore imperative that the surveys should extend at least to that depth.

To provide for such emergencies and to fill many other needs of navigators, soundings are taken for many miles out from the shore. An examination of any general sailing chart will show that from these soundings it has been found that as our continental shores drop off under the sea a definite point can be determined where the gradually deepening waters reach 5, 10, 20, and 100 fathoms, and therefore, what would be countour lines on the land are shown on the chart, only on the chart they are called the 5, 10, 20, and 100 fathom curves.

#### DEEP-SEA SOUNDING.

As it is impracticable to use the hand lead line for sounding where the depth is much in excess of 100 feet, below this depth soundings are made with a machine devised for the purpose. A much heavier lead is used and the line is replaced by wire wound on a drum operated by steam or electricity. When it is desired to take a sounding, the weight is released and the wire unwinds from the drum until the bottom is reached and the depth is recorded, then the drum is reversed and the wire wound in. When the ship has proceeded the desired interval, this process is repeated and another sounding recorded.

#### CLASSES OF HYDROGRAPHIC SURVEYS.

There are then three different classes of hydrographic surveys:

1. *Inshore hydrography*, used in bays, estuaries, etc., and along the coasts as far offshore as the surveyor can see the shore objects necessary for locating his position.

2. *Offshore hydrography*, when the surveying vessel starts at a known point situated at the limit of visibility of objects on shore, proceeds seaward the necessary distance, and returns shoreward until the shores can again be seen and the position located.

3. *Wire-drag surveys* in areas where the soundings indicate the possible existence of pinnacle rocks, boulders, or coral reefs undetected by the lead.

The necessary combinations of these three classes of work constitute a complete hydrographic survey.

#### PROBLEMS OF THE HYDROGRAPHIC ENGINEER.

Having thus given a review of the changing aims of the hydrographic surveyor from period to period during the existence of the Bureau, and having roughly divided our coasts into classifications

with respect to the different formations of the shore lines, it is here proper to say something of the problem now before the hydrographic engineer resulting from these different characteristics of the coastal formations, to what extent the old surveys can be utilized, and where they must be rejected as entirely inadequate and new surveys made.

In the very general classifications we have heretofore given of our coast lines, we have said that there are 11,649 lineal miles of general coast line of rocky or coral formation, and therefore fixed and unchanging, with the saving clause that in the shore lines included within this general classification would be found here and there stretches of considerable length of formations different therefrom.

With respect to coasts of fixed character the following remarks apply:

Where complete hydrographic surveys are made to a depth sufficient to safeguard any future increase in the draft of vessels the results are good for all time.

It is sometimes a matter of nice perception and judgment for the hydrographic engineer to decide the amount and character of the work necessary to insure the completeness of the survey. Along the Florida Keys the problem is plain. It requires only a few soundings taken at the beginning of the survey to indicate that this is an area which must be dragged before the survey can be considered complete. Knowing that such drag work must follow, the surveyor does not waste time using his lead in an attempt to locate every coral head, as he knows that the drag will later locate all such obstructions much more quickly and cheaply than could possibly be done with the lead.

Conversely, on the exposed coasts of California, Oregon, or Washington, where the waters deepen rapidly seaward and where there are no narrow, restricted waters that vessels must follow but everywhere plenty of sea room, it is obvious that wire-drag work is unnecessary and impracticable except in a few restricted areas in the vicinity of harbors. Here, therefore, the surveyor must make sure that sufficient soundings are taken to make the surveys complete. Although these waters are deep, there are also great inequalities in depth. Wherever the lead gives an indication of such inequalities by giving a sounding either materially deeper or shoaler than the surrounding ones, a further investigation must be made to trace out fully the differences in depth and make sure that none are so shoal as to constitute a menace to navigation.

It will thus be seen that a certain amount of information regarding any particular region is necessary before the Bureau can decide what work should be included in its survey, and the problem confronting the Bureau may be stated as follows:

1. Of the surveys made to date, decide which are adequate, and which should be supplemented by additional work.
2. Where the surveys are inadequate they should be supplemented by additional soundings, and where such soundings indicate the necessity, by wire-drag work.
3. In regions as yet unsurveyed, begin with the soundings, and as the work progresses decide what wire-drag work is necessary, and in

sounding be guided by the knowledge of whether or not such drag work is to follow.

In changeable areas the following remarks apply:

Experience has enabled the hydrographic engineer to judge quite definitely how often resurveys of such areas are required, and there are some general known natural laws that can be relied on. For instance, every inlet has its sand bar across its mouth, and the frequency of the necessity of resurveys of the bar is determined by local conditions. Such inlets as Absecon Inlet on the coast of New Jersey, or Grays Harbor on the coast of Washington where the bars lie inshore, require resurveys every year after the winter storms to keep the charts up to date.

Then, where waters such as Chesapeake and Delaware Bays have broad, open entrances and the deposit carried to the sea is diffused over large areas, the surveys at the entrances are required only about every 10 years.

Further, where we have large areas of protected interior waters such as Chesapeake Bay, Delaware Bay, and Mississippi Sound, surveys are required only about every 50 years.

Another feature of these sandy coasts is the result of the action of the sea waves and currents on the outlying shores. Here there is continual activity, with the result that where this year we find open waters sufficient for any steamer, next year we may find a sandy coast fully as substantial for all intents and purposes as is the land on which are built many of our coast cities.

#### CHANGEABLE COAST LINES.

An example of two of these changes may be of interest. There is shown opposite in black the shore line of Rockaway Inlet according to the survey of 1835, and superimposed on it, in red, the shore line of this inlet according to the survey of 1914. There the shore has advanced  $3\frac{1}{4}$  miles during a period of 79 years, and this is not given as an example of the speediest growth of the coast but more as an example of a rapid change in a locality that is commercially important, the Federal Government having under consideration the spending of nearly  $7\frac{1}{2}$  million dollars for the improvement of Jamaica Bay, and the city of New York upward of 70 million dollars for the same purpose.

Another example of these changes is Assateague Anchorage about midway between the entrances to Delaware and Chesapeake Bays. This is at present extensively used as an anchorage by schooners, tows, and other small vessels, usually in heavy northerly weather. Sixty-eight years ago there was no anchorage there. In 1849 Fishing Point, a bare sand spit, began to extend southward from the then existing southern point of Assateague Island, and since then a protected anchorage ground has been formed. From 1908 to 1911 the rate of growth of this spit was 200 yards per year, and from 1911 to 1915 it was about 100 yards per year. Fifteen different surveys have been made of this locality.

There is one other circumstance that may make immediately necessary a resurvey of large sections of those of our coasts that are of sandy formation. That is an unusually severe hurricane. Not long



after the hurricane along the coast of the Gulf of Mexico in 1915, this Bureau was importuned by the chamber of commerce of nearly every important city on the Gulf coast to make immediate resurveys of the entire coast, because the accustomed steamship routes had been entirely obstructed by the shifting of the sandy bottom of the Gulf. This resurvey was taken up as soon as our funds and facilities at hand would permit, though we are equipped only to determine the new channels for commerce and not to make the needed resurvey of the entire region. So far as this determination has proceeded it has been found that the changes are so great that the old surveys are valueless.

#### OFFSHORE SOUNDINGS.

As has been intimated, both for the determination of dangers to navigation and to enable masters of vessels to check their positions by taking soundings and comparing them with those on the chart, it is necessary to make surveys and determine the depth of water when the survey vessel making such soundings is so far at sea that she is out of sight of land.

Previous to the season of 1915 these surveys were taken in this wise: Signals were established along the coast where the survey was made. The surveying vessel would start directly to sea, making soundings at desired intervals and determining her position for each sounding by taking angle observations on the shore signals. So long as the signals were in sight and the angles could be observed on them, the positions of the soundings were accurately determined. So far the results of these surveys were and are of value.

However, when the vessel had reached a point where the shore signals were no longer visible, her position (and therefore the positions of the soundings taken) was estimated as follows: Her position was known at the time she left the sight of the shore signals and was plotted on the survey sheet at this point. Say, then, that she was run on a certain course for a certain length of time with her engines running at a known speed. Taking into consideration these two factors, it was then reckoned that she had reached a certain point, when she was stopped and a sounding taken, the position of the sounding being plotted on the survey sheet at the point that she was reckoned to have reached. Then she was put under way with the compass as a guide and run another period of time and a sounding taken, the sounding being plotted on the survey sheet at the position where the vessel was estimated to be. This was continued until she had proceeded the requisite distance to sea, which for the Atlantic coast is generally determined by the 100-fathom curve or where the depths drop off to 600 feet. Then she was put about, and in a like manner soundings were taken and plotted until she reached sight of the shore signals again.

#### OCEAN CURRENTS AND OFFSHORE SOUNDINGS.

The one element that was not sufficiently taken into consideration in the old method of making these offshore surveys was the effect of the ocean currents on the vessel throughout the run. In making

these soundings the vessel travels at the slow rate of about 3 or 4 knots an hour, and therefore whatever current there is has a greater effect in altering her position than if she had a speed of 18 or 20 knots an hour, because she is longer exposed to the action of the current.

#### PRESENT METHOD OF OFFSHORE SOUNDING.

Under the present system the offshore work is done as follows: First, high shore-signals are built; then buoys with signals that extend as far as practicable above the water are anchored just within the limit of visibility from the shore signals. This gives the added advantage of having the position of the vessel known not just as far offshore as the shore signals are visible but as far as the signals on the buoys are visible.

Before the vessel starts her run from the known position, current observations are taken and the direction and strength of the current are noted. We will say that her predetermined course was due east. Suppose when the current observation is made it is found that a current is running to the north. Then instead of heading the vessel due east, she is headed enough south of due east to counteract the effects of the current and held on that course for two hours, stopping to make soundings at the required intervals. After running this course for two hours, she is stopped and anchored and the direction and strength of the current determined. Suppose from this second current observation it is found that the current is running due east. Then instead of diverting the vessel from her course, the current is accelerating her speed, and she can be headed due east, but to the position that she would have attained by the speed of her engines must be added that of the force of the current. Thus it is that at each step of the journey account is taken of the direction and strength of the current and the course of the vessel altered to counteract the force of the current and keep her on her predetermined course.

Taking into consideration these elements and altering the course of the vessel to counteract the influence of the observed currents, the actual plotted course of one of our surveying vessels is shown on the diagram\* by the full line from "start" to "finish—observed currents applied." The actual position of the vessel when she came in sight of the moored buoys and determined it exactly was at the point "True finish." It will therefore be seen that where the vessel was thought to be when she finished her run was only about 5 miles from where she actually was, and consequently there was required only an adjustment of 5 miles over a course of about 130 miles, whereas plotting positions by "dead reckoning" there was an actual error of about  $32\frac{1}{2}$  miles in a run of about 140 miles, and therefore a readjustment was required throughout the course to distribute this error of  $32\frac{1}{2}$  miles over the course. As a matter of actual practice the error of 5 miles in the illustration\* is not characteristic, but the average error is generally not more than 1 or 2 miles, and in many instances the plotted position of the finish of the run and the actual position determined by angles on the moored buoys have been almost identical.

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\* Not included in this compilation.

## CONDITION OF THE HYDROGRAPHIC SURVEYS.

With the foregoing in mind, I shall now attempt to discuss the condition of the hydrographic surveys with respect to the shores of each of our coastal States, and of Alaska, Porto Rico, the Panama Canal approaches, Hawaii, Guam, and the Philippine Islands.

However, before doing this, it will perhaps facilitate the centering of the attention of those interested in any particular section of our coasts if this discussion is prefaced by a few notes giving the plan followed.

First, we will discuss the coasts of those States bordering on the Atlantic Ocean, beginning at the State of Maine, and taking up each feature of the coast of this State in its order as we proceed south. Likewise, each State in order touching the Atlantic Ocean and its tributaries to the south of the State of Maine will be taken up.

For general offshore work, where the same remarks apply to the coasts of several States, those sections of the coasts where the conditions are the same will be discussed as a unit.

Geographically, the different sections of our coasts will be taken up in the following order: (1) The States bordering on the Atlantic Ocean and the Gulf of Mexico, (2) Porto Rico, (3) the Atlantic approach to the Panama Canal, (4) the Pacific approach to the Panama Canal, (5) States bordering on the Pacific Ocean, (6) Alaska, (7) Hawaii, (8) Guam, and (9) Philippine Islands.

## SYSTEM OF CLASSIFICATION.

The system followed for the entire Atlantic coast is to divide the waters into three classes, inshore, inland, and offshore, and these will be taken up in the order named for well-defined sections of the coast. The terms are defined as follows: Inshore waters include all areas of moderate depth on the outside coast, from a depth curve arbitrarily adopted outside of which no dangerous shoals are believed to exist to the heads of navigation of all bays, sounds, and tidal rivers that have a navigable connection with the sea. The only exceptions are Nantucket Shoals, Georges Bank, and Cashes Ledge, which have moderate depths but which extend or lie far from the land and are included under offshore areas. Inland waters include shoal bays, sounds, and tidal rivers that can be used for through traffic by boats drawing not more than 10 and in most cases not more than 4 feet. Such waters are usually connected with the sea by shoal inlets and with other inside waters or with each other by canals, cuts, or dredged channels. Offshore areas extend from the outer limit adopted for inshore areas to a depth curve generally fixed at 100 fathoms on the Atlantic coast, which for most of the coast is near the edge of the continental shelf.

## INSHORE WATERS OF NEW ENGLAND, CANADIAN BORDER TO NEW YORK.

The coast of New England throughout its length presents practically one uniform problem to the hydrographic engineer. Surveys of varying degrees of completeness have been made of the entire area,

and it is possible for navigators to select channels which are apparently safe. They would be of ample depth if it were not for the ice-worn granite rocks of Maine and the large boulders deposited by the great ice fields from Buzzards Bay to New York, which alike form menaces to navigation. The lead line is not adapted to find without assistance dangers of this character. The wire drag alone is able to locate all these obstructions.

Ultimately, every bay and river must be surveyed by this method. For the present it will be necessary to continue the practice of confining the work to the important channels and approaches to the chief ports. Even this represents an immense amount of work, much of which should be finished now.

#### COAST OF MAINE.

The long stretch of Maine coast from the Canadian border to Frenchmans Bay is as yet untouched by the wire drag. There are a number of towns, however, that depend largely on water-borne traffic for their supplies. The exceptionally rocky coast makes it certain that a wire-drag survey will result in the discovery of many rocks which now endanger the safety of their commerce.

*Frenchmans Bay.*—Frenchmans Bay, with Bar Harbor and its other resorts frequented by yachts during the summer season, has been dragged, though not to the depth now considered necessary. The value of the work is further impaired by the necessity of passing over not less than 14 miles of undragged doubtful area in order to reach the bay from the open sea.

*Penobscot Bay.*—In Penobscot Bay every port has benefited by the practical completion of the wire-drag work. There are, however, some of the less important channels to be dragged, and some of the approaches from the eastward are not yet completed. The wire drag as used by the Coast and Geodetic Survey was developed in this region, and some of the area was not dragged to the depth now believed necessary. The size of vessels has increased rapidly, and additional work is necessary to protect this increased draft. As it has required time to solve all the problems involved in dragging to this greater depth, it is probable that much of the deeper part of Penobscot Bay will later have to be dragged to a greater depth.

There is a series of valuable inside passages along the Maine coast that are very narrow in places and wind between rocky ledges. Owing to the nature of the bottom they are particularly likely to be obstructed by pinnacle rocks or the extension of narrow ridges out into the channel. The only part of these channels which has been dragged lies between Blue Hill Bay and the western entrance of Penobscot Bay. The results obtained have been so startling that they clearly indicate the danger in the use of channels that have not been dragged.

The Penobscot River provides, by giving access to Bangor for vessels of moderate draft, an important means of communication with the interior of Maine, and it should be dragged.

From the western entrance of Penobscot Bay to Casco Bay there has been no wire-drag work done. The inside route is constantly used by coasting steamers, but it is certain that it has within its

limits many uncharted rocks, some known locally and some unknown. The Kennebec River to Bath and Augusta and Boothbay Harbor and its approaches are in urgent need of a wire-drag survey.

*Casco Bay and Portland.*—The approaches to Portland have been dragged with the result of finding numerous uncharted shoals, thereby furnishing important evidence of the need of completing the survey to the eastward and westward. The resurvey of inner Casco Bay where the glacial age has left a series of several hundred long narrow islands and ledges has not yet begun.

Westward of Portland the succession of sand beaches, of which Old Orchard is the best known, might appear to indicate an absence of rock in this region. The depth of sand above the underlying rock is not great, however, and pinnacle rocks occur outside these beaches. Westward of Cape Porpoise the surveys are entirely inadequate, and the need of immediate surveys is evidenced by the appearance on the chart of a rocky shoal with 5 fathoms or less, marked position doubtful. This was recently reported by a fisherman, but it has not yet been practicable to locate it.

The region from Boon Island to Isle of Shoals is very rocky and its importance as the approach to Portsmouth is so well recognized that a wire-drag survey is in progress. Many rocks have been located and the safest course for battleships is now known.

#### COAST OF MASSACHUSETTS.

From the north border of Massachusetts to Cape Ann the shores are entirely different from those to north or south. There are high sand bluffs in places and low sandy shores in others. As a result the waters along the shore are changeable, and though they have been recently surveyed, they will need further attention in the future.

The most complete extent of dragged area extends from Cape Ann to the Cape Cod Canal and from the head of Buzzards Bay to Sakonnet Point, R. I. With the exception of the inner part of Boston Bay and areas near the shores of Buzzards Bay, this important survey is complete. This work was made especially necessary by the opening of the Cape Cod Canal in 1915, as the original surveys had been made when the commerce of this region was relatively unimportant. Not only were a number of shoals found of less depth than that proposed for the canal, so that the system of buoying had to be changed, but it was realized that commercial needs may at some future date make it necessary to deepen this canal to take care of the largest vessels, and provision was made for such deepening. Even should a depth of 40 feet be adopted the present surveys will be found adequate, and where the depths are less the information will be invaluable to the engineers making the improvements.

Much of the traffic between eastern New England and points west and south passes outside of Cape Cod, most of it through Nantucket and Vineyard Sounds. Off the northern part of Cape Cod recent surveys are available, but in Nantucket Sound the entire route is through channels bounded by shifting sands. In one part of the most used channel, through Pollock Rip Slue, a shoal has formed in the last few years that has been steadily narrowing and decreasing

the depth of the available channel. A resurvey of parts of this route is needed every few years to insure safety of navigation. No rocks are found eastward of Cape Cod, but in the north half of Nantucket Sound and the western part of Vineyard Sound large boulders occur and wire-drag work is needed. At present vessels must pass over 10 miles of undragged area in following the best channel through Vineyard Sound.

#### COAST OF NEW YORK.

From Point Judith to New York it is almost unnecessary to go into particulars except to make it clear that other than in part of Block Island Sound practically no wire-drag work has been done and a complete wire-drag survey of all of Long Island Sound, including Fishers Island Sound, is required. The project to deepen East River to 40 feet makes it necessary to be certain where the channels with such depths are located in Long Island Sound. The work done in Block Island Sound has defined the limits of such depth in the eastern approach to Long Island Sound, and it is urgent that the rest of it should be undertaken without delay. The approaches to all the harbors on Long Island Sound should be dragged. Even the shoaler bays are filled with motor boats and the number of boats in operation for a given area is probably greater than anywhere else in the United States.

The Hudson River is a valuable waterway between New York and Albany and is a part of the canal system of the State. A few years ago a dangerous rock was found directly in the path of steamers between New York and Albany. With such a possibility all the doubtful parts of the Hudson should be dragged.

#### INLAND WATERS, MAINE TO NEW YORK.

There are a few inland waterways of minor importance, particularly Plum Island Sound on the Massachusetts coast, which have been recently surveyed. The Merrimac, Piscataqua, and Connecticut Rivers need additional surveys where not covered by the surveys of the United States Engineers in connection with improvements. There is a series of bays on the south side of Long Island Sound which either have been or are about to be connected one to the other so as to form a through channel from Jamaica Bay east of Coney Island to Peconic Bay at the eastern end of Long Island. There are two important inlets, Rockaway and Fire Island, that are subject to extremely rapid change, and these will require frequent resurveys.

#### OFFSHORE WATERS, MAINE TO NEW YORK.

The Gulf of Maine is a large body of water, a portion of the Atlantic Ocean, which so far as Coast Survey operations are concerned, may be considered as lying to the westward of meridian  $67^{\circ} 00'$  and extending to the Nantucket Shoals. This entire area has been surveyed but the surveys are inadequate. Not only are the soundings obtained insufficient, but many of them are not located correctly on the charts. A good example of this is the discovery

several years ago that only one shoal rock exists on Cashes Ledge, where two were charted, and that Sigsbee and Ammen Rocks formerly shown 4 miles apart are really the same rock.

These defects in the chart are serious for two reasons. The trans-Atlantic steamers approaching the ports of northern New England, especially Portland and Boston, are unable to depend on the charts sufficiently to locate themselves accurately by sounding. This is particularly serious during the fogs of summer which often extend far out to sea and last for days, and during the winter snowstorms.

In addition to this, the fisheries of the Gulf of Maine are an important national asset. The captains of fishing vessels were invited last year to furnish information in regard to uncharted shoals in the Gulf of Maine and to express their opinion as to the needs of the charts. Valuable information was obtained in regard to fishing banks not shown on the charts, and there was an almost unanimous expression of opinion that the present charts do not meet the needs of fishermen. Not only are many important fishing banks not shown, but the limits and depths of known banks are not correctly given. Besides, there is not at present enough information available as to the character of the bottom. The known existence of rocky bottom may lead to the discovery of good fishing grounds.

Extending eastward from Nantucket Sound there is an immense shoal area, consisting of sand ridges which are shifted by the waves and currents. Nantucket Shoals extend about 50 miles offshore, then there is a deep channel, and then comes the great shoal area of Georges Bank, which has several very shoal ridges. It is readily seen that it is important to keep the channels surveyed and to examine the adjacent shoals to detect changes, but it might readily be asked what is the use of surveying such areas as Nantucket Shoals which vessels are most careful to avoid. First, it is necessary to be certain that the outer limits of these shoals are clearly shown so that they can be avoided. Second, the shoals are important fishing grounds. Third, more careful surveys may develop safe channels for coastwise navigation, channels which are already indicated on the charts but are unsafe to use because of inadequate surveys.

The existing surveys are nowhere adequate and are particularly subject to wrong locations because of the strong and variable currents. The shoals are so numerous and the channels so intricate that a difficult problem is presented in their examination by sufficiently accurate methods. The ground fishing industry, especially for flounders, which has in recent years assumed large proportions, is steadily moving seaward, as an area once fished over has to be left for years to recover. Nantucket Island is during the winter the headquarters of this industry. Not only do the present charts not give the needed information in the search for new grounds, but the absence from the chart of existing shoals is a source of danger to the boats running to and from the harbor. Breakers often occur where there is ample depth for boats when the water is smooth. This is an excellent example of how a region usually avoided by commerce may be of importance to an industry which furnishes part of the food supply of the nation.

There is scarcely any part of our coast where correct soundings are of more importance than in the approach to New York from the

eastward, as all trans-Atlantic steamers bound to that port pass over this area. Many of them have to depend on soundings for safety. A fairly good survey of this area is available, but additional work should be done by modern methods in the portion out of sight of land so that the needs of the enormous traffic will be met. An especially important feature of trans-Atlantic commerce is the high proportion of large vessels and the consequent importance of their loss.

#### INSHORE WATERS, NEW YORK TO THE FLORIDA REEFS.

New York Harbor has had a recent survey, but as it is an area subject to change, it will require a survey, at least in part, every few years.

Along most of the coast of New Jersey the character of the bottom is such that the exact existing depths should be ascertained beyond all doubt, particularly as shoals dangerous to coastwise traffic have been reported from time to time. The only reliable surveys along this stretch of coast have been made in connection with searches for these reported shoals. Eastward of Cape May there are shoals that need a resurvey.

*Delaware Bay and River.*—Delaware Bay has as its most marked characteristic a series of narrow fairly deep channels separated by long narrow shoals. These shoals are likely to change. A resurvey is needed now, and one should be made about every 10 years in the entrance and at longer intervals in the upper bay. While dredged channels are maintained for most of the distance from the entrance of the bay to Philadelphia, vessels of moderate draft use the other channels. In view of the importance of the cities at the head of the bay and on the river, it is highly important that the needed survey of Delaware Bay be made so that a chart of the proper standard can be issued.

From Delaware Bay entrance to Chesapeake Bay there is a succession of shoals and banks. Many of these are buoyed so that moderate-draft vessels may pass inside of them. In such a region it is of the highest importance that the survey should be correct and kept up to date. At only one place has a comprehensive survey been made and this was the investigation of a reported shoal.

Chesapeake Bay and tributaries have been extensively surveyed in recent years, and a large part of them will not require resurvey for many years. This is also true of the Potomac River. The parts which need resurvey are the deep parts of the bay from Cape Charles to a point opposite Annapolis, part of the James River, and the Rappahannock and Susquehanna Rivers. This means that the intricate system of channels on the eastern side and the upper and lower ends of the bay are completed. The entrance has been recently surveyed, but another survey will probably be needed in 10 years.

From Chesapeake Bay entrance to Cape Hatteras there are only a few places where the shoals extend far from the shore. While a resurvey is needed, the most pressing need is that the limits of these shoal areas be accurately determined.

Diamond Shoals off Hatteras should be resurveyed chiefly to determine changes in their extent, and particularly to obtain a knowl-



edge of the correct depths on the seaward side, so that vessels passing too close may be warned in time.

From Cape Hatteras to Winyah Bay, S. C., the conditions are somewhat different. The changeable area along the coast is very narrow and existing surveys of the adjoining area of moderate depth are good enough for all requirements. Two areas are exceptions, the Cape Lookout Shoals and the Frying Pan Shoals, to which the remarks made in regard to Diamond Shoals apply, except that there is less traffic passing them.

From Winyah Bay to Fernandina, Fla., the chief characteristic is the distance from the shore to the outer edge of the shoal banks fringing it. Outside of these banks the water is fairly deep, and this region has been recently surveyed.

From Fernandina to the Florida Reefs, the area of moderate depths continually narrows until at Palm Beach the distance to the 100-fathom curve is very small. The completed survey extends southward to a little beyond St. Augustine. South of St. Augustine, the bottom is probably not subject to change except as noted below, and the surveys, while by no means complete, are fair. Off Cape Canaveral and outside the southern half of the Indian River there are extensive banks and ridges in urgent need of resurvey and which will have to be resurveyed at intervals. Known depths of 11 to 16 feet a long way offshore show the need of further surveys to make certain that all the shoals are correctly charted.

From Jupiter Inlet to Fowey Rocks, where the Florida Reefs begin, the deep water approaches so close to the shore that it will be a slight task to do the inshore work in connection with the offshore.

#### INLAND WATERS, NEW YORK TO THE FLORIDA REEFS.

This subject is usually considered from the point of view of the expense necessary to deepen channels so that small launches and even vessels of moderate size may traverse this inland route without being subject to the dangers of the open sea which may even prevent the passage of the smaller launches.

There is another important phase. These inland waterways are largely natural, and the use of the waters requires that correct charts be available. In fact, very often the chart furnishes the only means of finding the channels that have been deepened. It is evident that the Coast Survey should keep the charts up to date, not only for the larger boats which are now able to pass from New York to Beaufort, N. C., without going outside, but for the small launches which can go from New York to southern Florida through inside channels except for 150 miles of the North and South Carolina coasts.

The great interest that has been taken in this subject, its importance in relation to the national defense, and the amounts that have been expended in improvements emphasize the increasing need for charts based on surveys made with an understanding of present needs rather than on those made when it appeared that these waters would in many cases never be used.

While many portions of the 10-foot route from New York to Beaufort have not been recently surveyed, so much of it is through canals and through the deeper portions of the bays and sounds that it

is probably safe through most of its length. As soon, however, as the main route is left the defects of the charts become apparent.

The through route for small launches following the coast is in need of resurvey for practically its entire length. Several conditions exist. The main routes are probably over permanent bottom through most of the way, but the number of soundings in many cases is not sufficient to show exactly where the most water can be obtained. Where a few inches in depth may make the difference between a comfortable rate of progress and being stuck on a mud flat, the need for correct charts is self-evident.

#### THE INLETS.

The various inlets from the sea to these inland waters are subject to constant change, and usually this change extends for some distance both inside and outside of the inlet. These inlets are of such character that correct charts are impossible to maintain except with frequent surveys. Many of them should be surveyed every spring, after the winter storms, which would enable the Bureau to issue a fairly dependable chart of such inlets through the following summer. The Bureau of Lighthouses on each visit finds out where the deepest channel is and shifts the buoys to correspond, and it is important that the channels as shown on the chart be correct with reference to the buoys. Without such surveys the chart at times may not suffice even to find the buoyed entrance. Entering inlets always involves a certain amount of unavoidable hazard; but as it has to be done and often under the most dangerous conditions, with an approaching storm making it the only hope of safety, the charts should render all the assistance possible.

It is unnecessary to particularize the different waters of this through route along the coast, except the more important ones, as the same conditions occur throughout. New Jersey, Delaware, Maryland and Virginia (Eastern Shore), South Carolina, Georgia, and Florida, and portions of North Carolina are repetitions of the same story—bays and sounds of moderate depth connected by canals and dredged channels wherever the natural depths are insufficient.

#### NORTH CAROLINA.

The important inland waters of North Carolina are particularly valuable to this State because water transportation is possible over large areas where there are no railroads. Over much of the eastern part of the State lumber is either rafted or shipped by water to the distributing points. Agricultural products reach the market by boat, and the fisheries depend entirely on water transportation.

As a result of these varied uses in addition to the through traffic to the south, the entire area should be correctly charted.

*Albemarle Sound.*—Albemarle Sound and its tributaries, with a few exceptions, have been resurveyed within the last few years and will not require resurvey for a long time. The uncompleted portions, including the North and Alligator Rivers, should be finished in the near future as they form part of the through 10-foot channel system. The Chowan River, the western extension of the sound, should also

be finished, and this region would then be in a most satisfactory state.

*Croatan Sound.*—Croatan Sound, the connecting link between Albemarle and Pamlico Sounds, has been recently resurveyed, but the depth is so near to the draft of vessels using it that the surveys will have to be revised from time to time. Changes in the main channel have occurred within the last two years.

*Pamlico Sound.*—Pamlico Sound is chiefly important as a through channel. The eastern half of the sound is fairly well surveyed, and the work is now in progress. The entire western half and the Neuse River, which in addition to its local use is part of the through 10-foot channel, have not been resurveyed.

After passing through Pamlico Sound and part of the Neuse River, a narrow channel crosses to Beaufort where all vessels up to 10 feet draft go to sea. Small launches, however, may pass through Bogue Inlet and even farther to New River Inlet, if they wish to take chances in passing through the very shoal inlets.

From New River Inlet to Winyah Bay, S. C., all boats must pass outside, but from Winyah Bay to Key West there is an inside channel. Through South Carolina, Georgia, and Florida, the inside waters consist of rivers, sounds normal to the coast, and bayous. These waters are in urgent need of work to revise the older surveys, which were made from 30 to 60 years ago, and larger charts based on these resurveys are an urgent necessity.

#### OFFSHORE WATERS, NEW YORK TO THE FLORIDA REEFS.

Nature has provided for New York an approach which is nearly as easy to follow as a well-buoyed channel. The drowned valley of the Hudson extends as a well-marked depression for nearly 100 miles out to sea. The navigator who is uncertain of his position simply steers a course to cross this depression and when his soundings tell him that he has reached it, he changes course and follows it to the harbor. The absence of complete and accurate development of this channel, however, leads to some uncertainty as to its position especially at its outer end, and some of its possible value is destroyed by lack of sufficient soundings.

An explanation of the method used in locating a vessel by soundings will show why accurate charts are particularly needed from New York to Palm Beach and from Key West to the Mexican border.

At fixed intervals the vessel takes soundings, which are plotted to the scale of the chart on tracing paper, and this is moved over the chart keeping the line joining the soundings parallel to the course of the vessel until the soundings agree with those shown on the chart. If the charts are correct and based on a sufficiently modern survey, the method is the best known for locating the position when out of sight of land or when the weather conditions shut out the aids. If, on the other hand, the soundings are few and far apart so that the ship's soundings fall between them, and if those on the chart are wrongly placed, this method becomes much more difficult and an accidental agreement may lead the vessel into danger.

From New York to Cape Hatteras the charts are only fairly good, by no means good enough to meet the full needs of navigation, but

this work has been postponed as the need for resurvey has been so much more urgent farther south. Up to a few years ago the offshore surveys from Cape Hatteras to the Florida Reefs were almost unbelievably deficient. This condition is being remedied as rapidly as possible, and between Winyah Bay, S. C., and St. Augustine, Fla., the offshore work out to the Gulf Stream is complete.

It is important that this work be extended both north and south from its present limits as rapidly as possible. With adequate funds full advantage can be taken of the seasons, and by working in the north in the summer and south in the winter the cost of the work will be greatly reduced.

#### INSHORE WATERS, FLORIDA REEFS TO MEXICO BORDER.

If the wire drag is needed to make New England waters safe, it is indispensable in the region of the Florida Reefs. Coral rocks are not the result of a breaking-down process but of building up by the activity of animal life. The absence of weathering has resulted in a great variety of form and vast numbers of sharp projections from the general bottom where the conditions are favorable for the growth of coral.

While we are sure that an enormous number of uncharted rocks exist in this region, the fact that they are so numerous, that the region is so large, and that there is little navigation over much of it makes it practically impossible to drag the entire area, because of both the time and cost involved. Wire-drag work is accordingly recommended at present only where there is navigation by commercial and naval vessels or where maneuvering ground for naval vessels is required, and localities not now used but likely to be useful when dragged are included. Even this minimum represents many years' work. Areas that need wire-drag work, but where the cost is prohibitive, will have to be resurveyed by other methods, which will result in finding many though of course not all of the uncharted rocks. Some areas are considered as completed even if they are not surveyed by the standard applied to the more navigated regions, and the present surveys meet all the present requirements.

#### WIRE-DRAG WORK.

Vessels entering the Straits of Florida from the eastward have to force their way against the strong current of the Gulf Stream, which in places attains a velocity of 5 miles per hour. It is known that along the northerly edge of the stream and close to the reefs the current is very weak and at times runs to the westward. There is a strong temptation to keep dangerously close to the reefs and save fuel, and this is the cause of frequent wrecks. Aside from the danger of running onto the known reefs, which are in many places bare and are of no great depth throughout their length, another source of danger, the extent of which is not yet entirely known, has been discovered. A secondary reef, parallel to the main reef and about one-half mile outside of it, is found to approach the surface in places as a narrow ridge with depths as little as 25 feet. Over 20 miles along the reef have been examined; but nearly 200 remain. This work should

not be delayed, as it is of importance to nearly all of the great traffic entering the Gulf of Mexico.

Vessels bound for eastern Gulf ports naturally wish to take the shortest route. If of light draft, they can cross the Florida Reefs at Key West. The next channel is between Rebecca Shoal and Dry Tortugas, and if this is not used vessels must pass well to the westward of Dry Tortugas to avoid a shoal bank west of it. The Rebecca Shoal channel apparently has ample depth of water, but has a bad reputation among mariners, as several vessels have reported striking shoals in it. Part of this channel is now being dragged, and when completed a marked saving of time to vessels will result. The bank west of Tortugas should be dragged, especially as vessels making land from the westward may have to cross part of it.

Northward of the keys from Key West to Tortugas a doubtful area should be dragged. Several shoals have been found by the old method of striking them with vessels.

The channel between the keys and the reef known as the Hawk Channel is important for moderate-draft vessels. While it is not at present planned to drag it, it may be found necessary to drag the axis of the channel. Florida Bay has an excellent survey, though coral heads are very likely to exist here and there. The activity of coral growth does not appear to have been nearly so great on this side of the keys however.

#### CHARACTERISTICS OF THE GULF COAST.

The chief characteristics of the west coast of Florida are the distance to which shoal water extends offshore between Cape Sable and Cape Romano and from Tampa Bay to Apalachicola, and the existence of a number of large bays connected with the sea by deep channels either natural or dredged.

Comparatively few additional inshore surveys are needed, as the existing surveys, while perhaps not up to the standard of some other parts of the coast, meet the needs of existing and probable future navigation very well. Charlotte Harbor and Tampa Bay and their approaches are in need of resurveys. There is also a strip of sandy islands in each case which are subject to change and will need resurvey from time to time.

Off the Withlacoochee River a condition exists which, while common in other parts of the world, is otherwise unknown in the waters of the United States. Vessels approach this part of the coast to load phosphate rock, and as there are no harbors and the shallow water extends a long distance offshore they are compelled to anchor nearly out of sight of land, and their cargoes are lightered from the shore. A number of rocks have been struck in this region and additional surveys are needed. The anchorages commonly used and their approaches should be dragged. In stating that the inshore surveys of the west coast of Florida are generally complete, it should be realized that any commercial development that makes it necessary for large vessels to approach the shore will almost certainly result in rocks being found which do not interfere with existing navigation, and it will be the duty of the Coast Survey to make additional surveys wherever such development occurs.

From Apalachee Bay to Cape San Blas the coast begins to assume a character more like the south Atlantic coast, and coral bottom is no longer found. This stretch of coast is sandy, and sand shoals extend off some distance, especially in the vicinity of Cape San Blas. This region needs a resurvey and like other sandy portions of the coast will need resurvey from time to time.

The Florida and Alabama coast is somewhat different as deep water approaches close to the shore and the inshore surveys are considered complete except in Pensacola and Mobile Bays. All of the entrances, however, require frequent resurveys.

The coast of Mississippi and Louisiana has a very large proportion of changeable area, and resurveys are needed now and will be needed from time to time from Mobile Bay to the end of the offshore shoals south of Vermilion Bay. The immense load of sediment carried by the Mississippi River, especially in time of flood, causes constant changes in the Delta. The deposit of sediment and the action of the waves on the deposit results in rapid growth in some places and erosion in others.

Off the southern coast of Louisiana there is an extensive shoal region which is in need of survey.

The inshore waters along the rest of the Louisiana coast and the Texas coast with an important exception have deep water fairly close to the shore, and no additional surveys are needed. The exception is along the eastern part of the Texas coast from Sabine Pass to Galveston.

Sabine Bank and Heald Bank have shoal depths at a considerable distance from the shore, and they should have a thorough resurvey. Galveston Bay also needs resurvey.

#### INLAND WATERS, FLORIDA REEFS TO THE MEXICO BORDER.

Key Biscayne Bay, especially in the vicinity of Miami, is in urgent need of a resurvey. While the surveys of the shoal water between Cape Sable and the keys and among the keys are old they meet the demands fairly well and are not considered as needing resurvey. In most of this area the water is very shoal, and even light-draft launches require local knowledge.

From Key West to New Orleans the system of inland waterways is not nearly so continuous as on the Atlantic coast, but from New Orleans to the Texas border there is no break in them. Most of the breaks occur on the west coast of Florida where fortunately the inshore waters are shoal, and accordingly, there is not much swell or heavy breakers to fear. All the channels are in need of resurvey. Eastward of Pensacola there is a long stretch of inside channel through Santa Rosa Sound which needs resurvey.

From Mobile Bay to New Orleans there is one of the finest protected channels on the coast, Mississippi Sound. The line of islands on the outside is continuous except for the inlets, and protected waters for light-draft vessels make the water communication between Mobile and New Orleans exceptionally fine.

In this area the survey has been largely completed along the coast of Mississippi and when extended to Mobile Bay will be completed for a long time to come except at the inlets.

From New Orleans westward the inland route passes through a series of canals to Cote Blanche Bay. This bay is somewhat exposed to the sea, and its bottom is subject to change. A resurvey is needed now, and it will have to be repeated at intervals in the future. The remainder of the route is through canals and shoal bays to the Mexican border, and all the bays and sounds need resurvey.

#### OFFSHORE WATERS, FLORIDA REEFS TO THE MEXICAN BORDER.

Along the northern edge of the Straits of Florida the soundings are insufficient and they will have to be carried out somewhat beyond the 100-fathom curve.

The distance from the west coast of Florida to the 100-fathom curve is nearly 100 miles. Over much of this area the depths are moderate and the charts are based on reconnoissance surveys only. The bottom is coral rock in many places, and projections may arise sufficiently near the surface to be dangers to navigation. Fishermen have reported several uncharted ridges, and while the somewhat incomplete surveys which it has been possible to make so far of the reported localities have not confirmed all the details of their report, important differences from the charted depths were found.

The 100-fathom curve approaches fairly close to the Mississippi Delta; then swings offshore again so that it is about 60 miles south of Sabine Pass. It then swings to the southward in a curve which brings it within about 18 miles of shore at the Mexican border.

In surveying this area, it will be necessary to use particular care in the vicinity of the 100-fathom curve. There are authentic reports of shoals with 26 to 35 fathoms, with coral bottom very close to the 100-fathom curve, and one report states that a shoal with 11 fathoms exists very close to the 100-fathom curve southeastward from Galveston.

This whole offshore area is badly in need of a thorough resurvey, and there is no other part of the work in offshore waters that is so likely to be productive in furnishing important changes in existing charts.

#### PACIFIC COAST OF THE UNITED STATES.

The western coast of the United States is very different from the eastern. Generally mountainous, with comparatively few harbors or inside waterways and with comparatively deep water close to the shore, it presents little resemblance to the low shores and wide continental shelf of the Atlantic.

The purpose of the surveys is, then, to meet the needs of vessels approaching from seaward and of coasting vessels which keep to a few comparatively narrow tracks, to insure up-to-date charts of the various harbors, and to make soundings offshore to develop fishing banks that are known to exist.

The weather is an important factor in increasing the importance of the charts of this coast. From Los Angeles Harbor northward fog is very common in the summer time, and in the winter gales accompanied by thick weather are of frequent occurrence. On the coast in the vicinity of San Francisco thick weather is prevalent for perhaps 25 per cent of the time. Under such conditions the navigator must rely entirely upon his chart, and it is essential that detailed

surveys be made to beyond the limit of soundings taken by merchant vessels, which is the 100-fathom curve.

Along the shore of southern California much work was done up to 1895, and some of the surveys then made may be accepted as final. In the vicinity of the outer islands, surveys extend only a little way from the shore, and the deep waters between and outside of them are unsurveyed. The few soundings taken show irregular bottom and breakers have been reported in places where the chart shows 600 fathoms. These waters therefore should be surveyed out to the 1,000-fathom depth.

*Los Angeles Harbor.*—Los Angeles Harbor should be dragged, and minor local surveys are needed at a number of places along this coast.

From the western end of the Santa Barbara Channel to Monterey Bay the surveys as a rule extend only to the 50-fathom curve, which lies but a short distance offshore. These surveys should be extended seaward to include the usual track of coastwise vessels, which lies an average distance of about 10 miles from shore.

As an example of the need for wire-drag work, the results of the survey of San Luis Obispo Bay are striking. It was found that the large oil vessels entering this harbor were attempting to follow a channel with several dangerous rocks in its center. In fact, had the survey with the wire drag been made before the port was used by large vessels, the saving represented by the amount actually lost through strandings would have paid with a good margin the cost of all needed wire-drag surveys of the Pacific coast, exclusive of Alaska.

*San Francisco Bay.*—San Francisco Bay is of varied character of bottom and the needed surveys vary to correspond. The outer approaches are complete except in the vicinity of the Farallones. Here additional sounding is needed, and an investigation should be made with the wire drag to verify the existence of other rocks than those charted.

The bar outside the Golden Gate needs a resurvey. Wire-drag work has been carried through Golden Gate and inside both northward and southward from San Francisco to the limits of the rocky area. The southern part of the bay where the bottom is subject to change by the currents is in need of resurvey.

From San Francisco Bay to Point Arena a widely spaced system of sounding lines has been carried out to the 100-fathom curve. Here, an additional amount of work, about equal to that already accomplished, is necessary before the survey can be considered complete.

Between Point Arena and Cape Mendocino the surveys extend a uniform distance of 6 miles from shore, reaching depths varying from 50 to 200 fathoms. Additional detailed surveys should be made in the vicinity of each cape, and between them the work should be carried seaward to beyond the steamer track.

From Cape Mendocino northward to the Oregon boundary the limited surveys existing were made many years ago and are entirely inadequate. A complete resurvey should be made at the earliest possible date.

#### COAST OF OREGON.

One word describes the condition of the Oregon coast—UNSURVEYED. A limited amount of work was done years ago south of Cape Blanco



and in the vicinity of the Columbia River, but this was not more than a reconnoissance and does not extend out far enough to be of practical value to navigators. Elsewhere, no surveys have ever been undertaken.

Even in such an important locality as Cape Blanco, which must be rounded by all vessels plying between the Columbia River and San Francisco, there are no soundings to serve as a guide in thick weather, and vessels have been lost solely on account of this lack of surveys.

On the coast of Oregon are eight important harbors, on which the Government and private interests have expended approximately \$40,250,000 in improvements designed to facilitate navigation. One of these is the Columbia River, the gateway to one of the most important transportation centers on the entire coast.

Yet in spite of these immense expenditures for improvements, there is not a single one of these harbors the approaches to which have been adequately surveyed. The approaches to the Columbia have been sounded for a short distance offshore, but even in this area the soundings are too far apart to do more than indicate in a general way the depths which may be expected.

This partial survey extends southward along the coast to include the approaches to two other harbors. The approaches to the remaining five, on which \$3,826,000 have been expended in improvements, are entirely unsurveyed.

Perhaps the best comment on the condition of surveys on the Pacific coast is contained in the recent edition of the Coast Pilot, a publication of the Coast and Geodetic Survey, which with the charts forms the chief guide to navigators:

In using the charts it is well to remember that the surveys on which they are based were made many years ago, and are, in some localities, incomplete. The absence of soundings on charts of any given locality is an indication of lack of survey, and not that the locality is free from danger.

#### COAST OF WASHINGTON.

The statement just made regarding the Oregon coast applies equally to the Washington coast. The entire coast stands in urgent need of a first survey, except in the approach to the Straits of Juan de Fuca and in the straits themselves, where the present work is adequate. Willapa Bay and Grays Harbor have both been recently surveyed, but they both are of changeable bottom and resurveys will be required at intervals.

The interior waters of the State of Washington represent the point of change from a practically straight coast line to the broken formation of the coast of British Columbia and southeastern Alaska. There are many channels of importance leading to Seattle, Tacoma, Everett, Bellingham, and Olympia, and connecting with the inside passage to southeastern Alaska. All these waters should be dragged wherever there is the slightest doubt as to the presence of dangers to navigation.

Of the inside waters off the northern part of the Pacific coast little is known except that the Bureau of Fisheries, acting on the information obtained from fishermen, has located certain fishing banks. These banks should be surveyed to determine their depth and extent,

and it is believed that a general survey carried out to the 1,000-fathom curve will result in the discovery of other banks of great value.

#### ALASKA.

An important difference between Alaska waters and those of the continental United States is that scarcely enough work has been done to let us know just how much must be done to complete the charts. The development of the country has far outstripped the progress of surveys, not only because of the few vessels and parties engaged in the work but because of the great length of coast over which the various activities are scattered and the intricate system of channels for so much of its extent.

In order to appreciate the need of rapidly extending the surveys of these waters, it should be clearly understood that Alaska's only connection with the rest of the world is by the water routes.

The Government railroad now being built and the other existing lines are not trunk lines in so far as connection with the continental United States and Canada are concerned. The trunk line is the water-way from various ports in Alaska to Seattle and other west coast ports. The Alaska railroads and local steamboat lines are feeders only. The industries, which include chiefly mining of gold and copper on an immense scale and of various other minerals to a less extent, fisheries, especially salmon canning, but also supplying halibut and other fish to the market, agriculture and grazing, now of minor importance but developing, are scattered everywhere, and connection with the principal ports is by boat. The principal towns are on good harbors suitably located with reference to the steamer routes and the more important mines and canneries, and any town that loses any of these advantages soon declines in importance. In practically all cases the canneries and mines along the shores are visited directly by steamers. The value of water-borne commerce during the past year was \$110,368,178.

The amount of these natural resources ripe for exploitation has been so great and the prize they offered so tempting that transportation could not wait for the Government to make the way to them secure. It has gone ahead, finding its own path to each new field, suffering great losses in so doing, but content to suffer them because the returns were so immensely greater.

The Coast and Geodetic Survey, which in this field should have been the pioneer showing the way for commerce to reach each new enterprise, has, instead, been following impotently behind, charting dangers less from data obtained by its own surveys than from reports of vessels which have been wrecked on them.

It is high time that such a state of affairs be corrected, yet it will now take years before the surveys can reach a point where they can even meet the needs of present commerce.

In southeastern Alaska the first and most obvious need is to complete the wire-drag work. Most of these waters have been sounded, so that only dragging is necessary to complete this survey.

This drag work should be taken up in the order of its importance, beginning with the main steamer route through the region and then

taking up the various tributary waters leading to areas of commercial importance.

For some years past, two parties have been actively engaged in dragging the main steamer route, and this work is now about 55 per cent complete.

The outside coast of the islands bordering on the open Pacific and their connecting channels are largely unsurveyed, and have to be navigated with great caution. A navigator seeing a chart on which the shore line is sketched, no soundings, several rocks and shoal banks, notes as to rocks and breakers reported, and a statement on the chart to the effect that the area is unsurveyed is, to say the least, unable to proceed with confidence; and this situation is by no means unusual. The most pressing need of such regions is a complete hydrographic survey followed later in places by wire-drag work. The rapidly increasing commercial importance of this region and the exceptionally dangerous character of the waters through which traffic must pass, render surveys in the near future imperative.

*Cross Sound to Prince William Sound.*—From Cross Sound, the northernmost channel from the inside waters to the sea, to Prince William Sound the coast has few features of present or prospective importance. There is, however, urgent need for surveys to insure the safety of vessels approaching and passing along this coast. In this region the charts are very defective in the matter of showing soundings and prominent coastal mountain peaks and headlands that would enable the navigator to obtain his position on approaching from seaward. The only important break on this coast, Yakutat Bay, has some canneries, and additional surveys are needed here on this account.

*Prince William Sound to Unimak Pass.*—A very important section of the Alaska coast extends from the waters of Prince William Sound westward to Unimak Pass. Not only are the industries of present importance, but there are extensive mineral resources, largely undeveloped through lack of cheaper transportation. The point to be emphasized is that this is not an old, settled country with its needs in the matter of transportation fixed, but it is still capable of great future development, and in considering the needed surveys this future must be taken into account.

The approaches to Prince William Sound have been surveyed and need no resurveys for the present except in the vicinity of Cape St. Elias and Middleton Island. Wire-drag work will be needed in both these localities as reefs and pinnacle rocks exist.

Prince William Sound needs additional soundings over most of its area, and many of its branches need original survey.

Cordova is the terminus of the Copper River & Northwestern Railway which gives access to the important copper mines on the Copper River. The approaches to Cordova have been surveyed except for wire-drag surveys needed to insure complete safety.

Seward, on Resurrection Bay, is the terminus of the Alaska railroad now being built by the Government. The surveys of its approach are completed except for wire-drag work.

It is probable that much of the freight originating along the line of the Government railway will be transshipped at Anchorage at the head of Cook Inlet. Not only will this make it necessary for many

vessels to navigate these waters, but there are now very large salmon canneries all along its shores, as well as considerable mining. The present surveys are inadequate and wire-drag work is needed over much of its area.

Kodiak Island, with a number of canneries and with some cattle grazing, is largely unsurveyed.

From Kodiak Island westward to Unimak Pass only a comparatively small part has been surveyed at all. While the amount of present traffic is small it is sufficient to need protection. At present the Coast Guard vessels and the freight and passenger vessels run grave risks in using the protected natural channel leading along the coast inside the islands. This is a particularly bad stretch of coast with many reefs and islands. Only in the vicinity of the Shumagin Islands and from Unimak Pass to Unalaska Islands have surveys been made, and they are inadequate. It is not now practicable to drag the entire area, but it is important that the immediate needs of navigation, even though of limited amount, be met by dragging a selected channel to insure the safety of vessels from Shelikof Strait to Unimak Pass.

Unimak Pass is the almost universally used channel into Bering Sea. It has been surveyed, but it is probable that part of it should be dragged or that at least further soundings be taken.

*Aleutian Islands.*—The Aleutian Islands have comparatively little traffic and are without surveys. It is necessary that this region be patrolled by Coast Guard vessels. In the wreck of the *Tahoma* several years ago there was a loss to the Government equivalent to the cost of surveying a large part of this area. This is an excellent example of how in a region of almost no traffic the needed surveys cost little more than may be lost by the existence of a single uncharted reef.

*Bristol Bay.*—A large part of the salmon shipped from Alaska comes from Bristol Bay. This is without survey except in Nushagak Bay and Kuskokwim Bay and River. Both of these have recent surveys, but as the bottom is subject to change on account of the large rivers, future additional surveys will be needed. As an example of what surveys mean in a new region, the discovery of an entrance to the Kuskokwim River suitable for moderate-draft vessels opened up an immense area suitable for grazing and also in places for general agriculture. An interesting industry is the raising of herds of reindeer.

*Norton Sound.*—Norton Sound is important for gold mining on its shores and as the mouth of the Yukon. In all of Norton Sound additional surveys are needed. It is curious that in this sound, which according to all available information is of quite level sandy or muddy bottom, Besboro Island, rises very abruptly to a height of 1,012 feet. With such an occurrence it is not absolutely certain that no pinnacle rocks exist.

*Port Clarence.*—Port Clarence just south of Bering Strait has canneries of some importance. While a survey has been made, additional surveys are needed.

*Bering Sea and Arctic Ocean.*—Except in the vicinity of Pribilof Islands, there are no other existing surveys in Bering Sea or to the north which can be considered of value.

## OUTLYING ISLANDS.

## PORTO RICO.

When Porto Rico came under the jurisdiction of the United States as a result of the Spanish-American War, one of the pressing needs was an adequate survey, in spite of the fact that it was among the first discovered and settled of the West Indies. This work was intrusted to the Coast Survey, and the surveys were begun without delay. By 1910, the survey was completed and a sufficient number of deep-sea soundings were taken around the island.

There are, however, extending to the eastward and westward of the island and along the south coast, extensive areas where the bottom is of coral formation. There are also reefs along the north coast, but as they are close to shore and must be avoided by vessels, it is only important to know their location, and no extensive surveys are needed in their vicinity. The other areas mentioned above are different in that there is traffic between the reefs and over areas where the depth is little greater than the draft of the vessels, and the existence of uncharted projections can cause wrecks. Vieques Sound between Culebra and Vieques Island east of Porto Rico, Virgin Passage, and the approaches to the harbors of the American Virgin Islands are in need of wire-drag work. The only work of this character that has been done was in the vicinity of Mayaguez. This work resulted in the abandonment of one channel and the re-buoing of another.

Wire-drag work should be in progress now, and it is only delayed by the lack of launches that can do the work in the rough water caused by the trade winds.

## GUAM.

The present chart of the island of Guam is compiled from Spanish and British charts and some harbor surveys by the United States Navy. No attempt at a comprehensive survey has been made. A complete survey should be made, not only including the harbors, but the surrounding waters, carrying the survey out to a depth that will be certain to include all dangers. In these waters shoals rise abruptly from great depths, and the absence of soundings on the charts does not imply safety but simply absence of surveys.

## HAWAIIAN ISLANDS.

There are only two good harbors in all the Hawaiian Islands and both of these are on Oahu Island. All of the islands except Hawaii have coral reefs around at least part of them. In the vicinity of Oahu, Maui, Kahoolawe, and the south coast of Molokai the surveys are fairly complete. In the vicinity of Hawaii, the surveys are very inadequate except in the only harbor, Hilo Bay. The west coast of Lanai and the vicinity of the two westernmost islands, Kauai and Niihau, are practically unsurveyed. The various channels between the islands from Maui to Oahu are fairly well surveyed. The others are practically without survey.

## PANAMA CANAL APPROACHES.

The Atlantic approach to the Panama Canal has been surveyed since work started on the canal construction. Limon Bay is, however, a region where pinnacle rocks occur, and one of these was struck by the U. S. S. *South Carolina*. All the anchorages should be dragged, and the work should be carried a short distance outside.

The Pacific approach to the canal has had a recent survey and has been dragged. No further surveys are needed at present.

## PHILIPPINE ISLANDS.

Active work was commenced by the United States Coast and Geodetic Survey in the Philippine Islands on January 1, 1901, and it has been prosecuted continuously since that time.

On September 3, 1901, a proposed plan for the division of expenses between the Governments of the United States and the Philippine Islands, which had been approved by the Secretary of the Treasury of the United States, was submitted to the United States Philippine Commission for consideration and was later approved. On January 1, 1902, the plan of cooperation, as submitted, was carried into effect.

Since January 1, 1902, the work has been conducted under the joint agreement, which provides that it shall be under the general supervision of the Superintendent of the Coast and Geodetic Survey, at Washington, D. C., represented by an officer of the regular field force of the service designated as Director of Coast Surveys, Philippine Islands, who shall, however, report to the head of the Insular Government, so far as concerns the expenditure of funds furnished by that Government. It also provides for a specified division of expenses, which has resulted in the payment of 35 per cent of the total expenses by the Government of the Philippine Islands.

The details of the work are arranged through a suboffice established at Manila, where all records are received, computations are made, charts and sailing directions are prepared, and information is supplied to navigators, engineers, and others.

Five steamers fitted out for making complete surveys, including triangulation, topography, and hydrography, are employed in the field work, while in addition, working parties are sometimes established in quarters on shore, with launches and small boats equipped for use in making surveys.

The Philippine Islands are composed of not less than 3,000 islands and islets covering an area of approximately 115,000 square miles, about the same as that of the five New England States and the State of New York combined.

The total length of the general coast line, measured on small scale charts (1:400,000) using 3 mile spaces of dividers and omitting islands and bays less than 3 miles long is approximately 10,850 miles, or about the same as that for the entire Atlantic coast of the United States, including the islands. About 75 per cent of this shore line has been completed.

The unsurveyed hydrography covers a large area on account of the necessity of extending this work, in some localities, for many miles offshore, and on account of the very extensive area of the

Sulu Sea. It is estimated that about 50 per cent of this class of work has been completed.

The triangulation has been carried over the greater part of the coasts of the islands, there remaining a few scattered localities where only tertiary triangulation will be necessary, all of the triangulation of a secondary class required for the coasts having been completed. There is a connected system over the greater part of the coast and the adjustment to a uniform datum can proceed without interruption.

It is estimated that 64 per cent of the entire work of surveying the islands was completed at the close of the fiscal year 1917.

The surveys of the coasts of the Philippine Islands have covered all of the localities that are at present of any commercial importance, the remainder of the work being in localities many of which are dangerous to navigators, but which, at the present date, are seldom visited by vessels engaged in trade.

The unsurveyed regions are as follows: The northeast coast of Luzon from Polillo Island northward to Aparri; the region off the north coast of Luzon, including the Babuyan Islands, Balintang Channel, the Batan Islands, and Bashi Channel; the entire west coast of the island of Palawan and about one-half of the east coast of the same island; the west coast of Mindanao, from Blanca Point, south to Zamboanga; the south coast of Mindanao, from Pola Point to Malita, in Davao Gulf; the Sulu Archipelago and the Sulu Sea from Cuyos, south to the limits of our possessions off the coast of Borneo.

*Northeast coast of Luzon.*—This entire unsurveyed region, from Polillo Island on the south to Aparri on the north, is of little commercial importance, and being quite free from dangers to navigation, the execution of the work is being delayed until more important sections are completed.

Little reliable information relating to this region is available, but a number of good anchorages have been reported. Among these are the inner harbor at Port San Vicente, Casiguran Bay, Dilasac Bay, and Dingalan Bay. The first two mentioned are excellent typhoon harbors, and as the greatest distance to one or the other could not exceed 100 miles, there is no reason why this work can not be executed with safety and dispatch, although it must be done during the season of frequent typhoons, it being impossible to work at any other time of the year on account of the heavy sea.

*Off north coast of Luzon.*—A survey should be made of the islands and the waters to the northward of Luzon as far as Bashi Channel, as, in accordance with the numerous reports, there is considerable uncertainty in regard to the true location of the islands, and the rocks and dangers to navigation in the locality. As it is in the region visited by frequent typhoons, the work should be undertaken during the period when typhoons are less frequent.

*West and east coasts of Palawan.*—The coast line of the island of Palawan is very irregular, indented with deep bays forming some of the finest harbors in the archipelago. The whole region about the island and extending southward to Balabac Island, Banguay Island to Cagayan Sulu, and off the north coast of Borneo, consists of coral reefs, many small islets, and innumerable hidden dangers to navigation. To the westward of Palawan, reefs and dangers extend to over

100 miles offshore. The hydrographic survey of this region involves an immense amount of labor. A preliminary survey for the location of channels through the reefs and entrances to harbors will first be necessary, after which these localities must be swept with the wire drag.

*West coast of Mindanao.*—The necessity for the survey of this unfinished portion of Mindanao, from Blanca Point to Zamboanga, a stretch of about 150 miles, is not urgent, as the region is of no commercial importance and is known to be free from dangers to navigation. It is the intention, however, to take it up as soon as there is a favorable opportunity in order that the circuit of the island of Mindanao may be completed. The coast is bold and rocky, exposed to both the northeast and southwest monsoons, and there are only a few months in the year, before the change in the monsoons, that are favorable for work in this region. April, May, and June are probably the most favorable, as during these months the winds are usually light and at times variable.

*South coast of Mindanao.*—This stretch of about 160 miles, from Pola Point to Malta in Davao Gulf, involves no great difficulties and will be taken up as soon as the surveys in other localities of greater importance for the safety of navigation have been completed. The coast, in general, is bold and steep, with numerous outlying reefs which, however, do not extend a great distance from shore.

*Sulu Archipelago.*—This region, about 75 miles wide, extending in a southwesterly direction from Zamboanga on the southern coast of Mindanao, to the coast of Borneo, a distance of about 180 miles, has scattered over it about 300 islands and islets and numerous hidden dangers to navigation. It requires a survey of the most careful and intricate character, and much of the locality must be swept with the wire drag. The formation is coral and dangerous to navigation, as rocks are frequently found in localities where they are least expected to exist. The currents in the region are very strong. The physical conditions are such that excellent control can be obtained and little traverse work will be necessary.

For many years the pirates of this locality have been a terrible scourge, and unless conditions change, military protection will be necessary during the execution of the surveys.

*Sulu Sea.*—This body of water, averaging 350 miles in length and 300 miles in width, is located between the islands of Mindoro on the north, Panay, Negros, and Mindanao on the east, Sulu Archipelago on the south, and Palawan on the west.

The northern end, as far south as the Cuyos has been surveyed with a fair degree of accuracy, but owing to the coral formation, where hidden dangers frequently exist, wire-drag sweeping will be necessary in selected passages.

The entire region to the south of the Cuyos remains unsurveyed except for a reconnaissance and approximate locations by navigational methods.

Numerous rocks and reefs dangerous to navigators are scattered throughout the sea, but certain well-defined passages have been examined with sufficient accuracy to make navigation through them reasonably safe. The survey of the entire region south of the Cuyos will be taken up as soon as work in more important localities has been completed.



## OCEAN CURRENTS.

No discussion of means designed to safeguard navigation is complete without a consideration of the subject of currents, since it is to their action, occurring unseen and unsuspected, that so many disasters are due.

To this subject the Survey has devoted a great deal of attention in recent years and at present publishes current tables for a number of localities, giving information of great value to the navigator. It hopes, however, to prosecute its studies still more vigorously in the future, so that the scope of the information so furnished can be materially expanded.

While it would be an interesting inquiry to determine, if possible, the mooted question of whether currents have their origin in prevailing winds, the difference in salinity and therefore difference in density of the ocean waters, or rainfall and evaporation, such is not the business of the Bureau.

Our duty is confined to the more practical subject of determining where and under what conditions currents exist and their strength and direction, and these are not so much the result of scientific research as of direct practical observations of the actual currents themselves.

From the practical standpoint of the navigator, currents may be divided into three classes.

1. Tidal currents: Since these are the result of known forces, acting under known conditions, their prediction offers no difficulty.

It is well known that the principal tide-producing force is the combined attraction of the sun and moon. Since the relation of these two heavenly bodies to each other is constantly changing, passing through a complete cycle once every lunar month, their combined attraction, and consequently the tides themselves, pass through similar monthly cycles. In order, therefore, to secure data on which to base predictions of the tidal currents at any given point, it is only necessary to take continuous measurements of the velocities and directions of the currents actually existing and to note the times of slack water as the current turns from flood to ebb or from ebb to flood.

From the data thus obtained for any one lunar month, the currents which will occur during any other month can be predicted, with the understanding of course, that there may be temporary fluctuations due to storms, freshets, etc. In fact, fairly accurate predictions can be made from observations taken during a period of considerably less than a month's duration.

2. Currents of the type exemplified by the Gulf Stream, where the occurrence is continuous, the flow always in one direction, and the velocity at any point fairly constant except when temporarily modified by weather conditions.

The study of such a current must include the determination of its velocity at different points under normal conditions, and also the determination of the amount by which that velocity is affected by different weather conditions. For this purpose, the method used may be that already described, but it is obvious that the observations must extend over a longer period in order to include the effect of varying weather conditions.

3. Currents which may be described as accidental in character. These occur apparently as a result of certain transitory localized causes, and in consequence, are shifting and variable.

The dangerous currents of the Pacific coast of continental United States are of this character. These may be flowing north one week and south the next, or they may die out entirely; but as they have been known to attain velocities of from 2 to 3 miles per hour, it is of the utmost importance that they be carefully studied and a method found for informing navigators when they will be encountered.

Obviously, this is a different problem and one that will require a long period of observations to solve. Such studies as have been made, however, have indicated a practical way of solving it, provided the necessary observations can be obtained.

Thus, it appears that the chief essential necessary for furnishing navigators with information regarding the currents is a series of actual measurements of the currents themselves, extending over periods of varying length, depending on the character of the currents.

In the inland waters where shelter is afforded and where the currents are tidal, necessitating observations over short periods only, it is practicable to use small launches, so that the necessary results can be obtained at a moderate cost. But in the open unprotected waters of the outside coasts, where observations must be taken continuously over long periods and where it is particularly important to obtain such observations during periods of stormy weather, a staunch seaworthy vessel must be provided.

To build or charter a vessel solely for this purpose would make the cost very great, and it is for this reason that in the past we have had to be content with the meager current information that was obtained during the course of the various hydrographic surveys.

However, this matter has been given serious consideration, and some years ago a plan was evolved through which it was hoped to remedy this defect, which plan has, however, through lack of sufficient legislation, been thus far unexecuted.

Briefly, the plan contemplated was this: The Bureau of Light-houses maintains along our coasts anchored lightships that serve as aids to navigation. These ships are for the most part at points on the tracks of vessels where it is desirable to have information regarding the currents. As these ships are anchored (and therefore confined to a limited area), the plan was to have continuous current and meteorological observations made from these ships throughout the year. From the data thus obtained it should be possible to derive general laws on which reliable predictions can be made as to the direction and strength of currents under all conditions. With the aid of these general laws predictions could be made for the occupied stations, and actual observations made at points between the lightships would then enable us to secure data on which to base predictions for all our coasts.

However, this matter will be discussed further under the head of "Needs of the field service" in Chapter II.

#### GEODETIC WORK.

Every civilized nation recognizes the need for having geodetic surveys that are used to control the detailed mapping and surveying and its engineering work.

The geodetic work that is of the greatest economic and commercial value is primarily triangulation and precise leveling. In order that these may be better understood, there will be given a brief explanation of the problems that confront a surveyor when he is making a map over an extended portion of the earth's surface.

As is well known the earth's surface is spherical and not plane. In the surveying with which most of us are familiar, the area over which operations are carried is so limited that it may be considered as lying in a plane. This condition may be assumed for areas of even several hundred square miles. When such an area is surveyed, for purely local purposes, an initial point may be assumed for the operations. Then, by measuring distances with a tape or chain and getting angles with a small engineer's transit, control points are established into which are tied the various lines and points of which the survey is composed. Such a survey might be that of a park where the object to be accomplished is to show on a map the boundary of the area covered by the park, the roads, streams, hills, woods, buildings of various kinds, and any other natural or artificial features whose positions relative to the boundary lines are needed.

The average farm survey is similar. Here we would have some starting point, such as a tree or a rock or a concrete monument, and from this point a traverse by compass and chain, or by some other plane surveying method, is extended around the whole farm. Following this, various topographic features on the farm would be tied in to the boundary lines by distances and angles measured on the ground.

In such areas as we have been considering there has been no necessity to treat the earth's surface as being curved, but suppose it is desired to cover an area as large as that of a State, say 100,000 square miles in area. Such an area would have such a large curvature, since it is a large section of the surface of the sphere representing the earth's figure, that special methods must be employed to avoid distortions and to make it possible for the surveyor properly to determine directions and distances between various points within the area considered.

When we take into consideration the shape and size of the earth, and of course its curvature, in making a survey, such a survey is called a geodetic one. All of the surveying operations by the Federal Government, with few exceptions, are geodetic in the sense that the curvature of the earth is taken into consideration. This applies especially to the work of the Coast and Geodetic Survey, the topographic mapping by the Geological Survey, and much of the work of the General Land Office.

In order to make surveys over large areas and to have the results harmonious, it is absolutely necessary that some method be employed to locate very accurately some points that can be used to control the position of the surveys. Such a method is that of triangulation. This may be described briefly as a series of points located on the most prominent mountain peaks and hills, or in the case of a flat country, points on which towers are erected in order to raise the instruments with which observations are made above woods, houses, and other obstructions. Two of these points are selected as the ends of a base line, and the distance between them is measured very accurately with a metal tapeline.

Each of the points is permanently marked by a tablet set in a concrete block or in solid rock. Over each one of these points is erected a stand if on a mountain peak, or a tower if on a wooded hill or in a flat country. These stands and towers are accurately centered over the tablet in the concrete or stone monument. The next step in the process of carrying on triangulation is to observe with a theodolite, which is a very high grade engineer's transit, angles at each of these points between each two of the points that are near it. In this way a series of triangles is formed.

It is a well-known mathematical principle that if any three elements of a triangle are known (the elements being the three sides and the three angles), one of which is a side, the other elements can be computed. In the present illustration, we would have one side known in what may be called the first triangle. This is the side which is measured directly with the metal tape. We also have the three angles of the first triangle. With these angles and the one side which was measured directly we can compute the other two sides of the first triangle. The next step would be to compute the lengths of the sides of the contiguous triangles using the two computed sides of the first triangle as bases. As the triangles are in a connected system, there will be many lines which are common to two triangles and we can, therefore, use the computed sides of some of the triangles as bases from which to compute the sides of the other triangles and so on throughout the scheme.

Before the triangulation can be utilized to the best advantage, some system of coordinates must be adopted in order that a point of the triangulation may be given a position that will harmonize with the position of the other triangulation points or stations. The origin of coordinates adopted by the United States and by nearly all other countries is the intersection of the meridian (the true north and south line) which passes through the observatory at Greenwich, England, and the earth's equator. This intersection of the meridian and the equator has a zero latitude and zero longitude. All points in the United States, which are referred to these two lines, will have north latitude and west longitude.

It is a comparatively simple matter to find the coordinates of a point with relation to these two lines by making observations on the stars by which are determined the latitude or distance above the equator and the longitude or distance west of the meridian of Greenwich. The determination of the latitude and longitude of such a point can be made with almost any degree of accuracy that is required. Such a point can be used as the initial point for the triangulation of the whole country. A point like this would be included in the triangulation scheme mentioned above. At such a point there would also be observed the true direction of the line joining one of the other points that are near by.

With the latitude and longitude of the initial point, the true bearing of one of the lines radiating from this point, and the distances and angles of the various triangles, one is in a position to be able to compute the latitude and longitude of each of the other points in the scheme of triangulation and the true bearing of each of the lines.

One can readily see that, in the area of 100,000 square miles of which we spoke above, many surveyors could begin operations if the whole area were covered by a triangulation and the longitude and latitude of many points had been determined. The position of the map made by each of the surveyors with relation to the system of coordinates could be accurately determined and when all of the maps were joined to make a single map of the whole area there would not be any distortion in it, nor would there be overlaps, gaps, or offsets where any two maps of small areas were brought together. We should find that the longitude and latitude of a topographic feature shown by one surveyor would correspond to the longitude and latitude of that feature as shown by the other surveyor.

The area of the United States is approximately three million square miles and the extent of its coast line is many thousands of miles. It was soon found in making the charts along the coasts in the early part of the last century that when two systems of triangulation were joined there was developed a discrepancy that was troublesome to the chart makers. For instance, the triangulation stations that had been established along the coasts of the New England States and the maps based upon them were harmonious among themselves, but they did not agree exactly in latitude and longitude with the triangulation made along the coast of New York and New Jersey. In other words, the longitude and latitude given for the stations where the two systems joined, were not exactly the same as computed through the two separate schemes of triangulation.

It was early discovered that the reason for this discrepancy was due not to errors in the observations in the astronomic stations, which were used as the initial points of the triangulation, but it was that the unevenness in the surface of the continent caused the plumb line, to which all astronomic observations must be referred, to deflect toward the mountains or high ground and away from the valleys or low ground. As a concrete example of this deflection, we may cite the case of the triangulation in Porto Rico.

Before the Spanish War an astronomic station had been established at San Juan on the north coast of the island, and another astronomic station near Ponce on the south coast. Shortly after the war a triangulation was extended across the island between these two places, and it was found that the distance across Porto Rico as given on the map constructed upon the two astronomic stations was about 1 mile greater than the actual width of the island. The true distance was given by the triangulation.

It was at once concluded that the reason for this discrepancy was the presence of the mass of the mountains on the island, which attracted the plumb line at both Ponce and San Juan, and the presence of deep water in the Atlantic Ocean and the Caribbean Sea which, on account of the deficiency of density, as compared with the base of the island, repelled the plumb line away from the water and toward the island. The cumulative effect was that the plumb lines, instead of pointing in what might be called the normal positions at the two stations, were drawn toward each other, and thus during the observations on the stars, a greater angle in the heavens was subtended by the two plumb lines than there would have been had there been no abnormal conditions present near the astronomic stations.

In the United States there have been observed a number of cases where the so-called deflection of the vertical was large. Had the stations at which these deflections were found been used as the starting points for triangulation, then large discrepancies would have been found when the various separate schemes of triangulation were joined. As a matter of fact, there were discrepancies found when each two separate schemes of triangulation of the country were connected.

In order to eliminate the effect of the deflection of the vertical, strong schemes of primary triangulation were extended along the Atlantic coast from the eastern part of Maine to Pamlico Sound, N. C. A branch from this triangulation was also extended along the eastern slope of the Appalachians to Mobile, Ala. When this arc was completed, it was possible to strengthen and connect the separate sections of triangulation that had been made along the Atlantic and Gulf coasts for the purpose of controlling the topographic and hydrographic surveys that were made to furnish sailing charts of our coasts.

It was later found necessary to connect the Atlantic and the Pacific coasts with a strong arc of primary triangulation, which was run along the thirty-ninth parallel of latitude. When this triangulation was done, it was possible to coordinate the surveys that had been made for charting purposes along the Pacific coast with those along the Atlantic and Gulf coasts. A strong arc of primary triangulation has also been extended along the entire Pacific coast of the country, in order to coordinate and strengthen the separate schemes of tertiary triangulation that had been done for the control of the hydrographic and topographic surveys. These surveys had been made to furnish data for sailing charts of the Pacific. This work was similar to that done on the Atlantic and Gulf coasts, mentioned above.

In order that the triangulation stations of a country may be located most nearly in the ideal places on the earth's surface, a number of astronomical stations must be connected with the triangulation scheme and an average position assumed which will be most nearly freed from the effect of the deflection of the vertical at the separate astronomical stations. This was done in the United States with the result that our whole system of maps is in nearly the ideal position.

The advantage of having a primary triangulation covering the whole country is very great, for it enables engineers and surveyors to coordinate all of the public and private surveys throughout the country. It is also important that a whole continent be covered by a continuous network of primary triangulation all based upon the same initial point in order to avoid the errors due to the deflection of the plumb line at the various stations.

The situation in North America is unique, for the United States, Canada, and Mexico have decided to extend their primary triangulation in such a way as to have it continuous over the whole continent. This makes it possible to obtain accurate distances and directions between points of one country and those of another. It also insures harmony in the maps on the international boundaries where ordina-

rily there is much confusion resulting in misunderstandings and trouble along the borders.

One might think, when the primary triangulation had been done that controls the positions along the Atlantic and Gulf coasts and along the Pacific coast and the primary triangulation had been extended across the country to join the eastern and western coasts of the United States, that the geodetic work of the Coast and Geodetic Survey would be complete, as far as the needs of this Bureau are concerned. This is largely true, but after having met the demands of the Bureau for controlling the sailing charts along the coasts, it is found that there is hardly an area of any size in the whole United States, in the interior of the country, that is not dependent on geodetic control for maps and surveys. For a number of years this Bureau has been extending other arcs of primary triangulation in the interior of the country, and its present plan, which may, of course, be greatly modified in the future, is to extend rapidly the triangulation in order that there may be no place more than about 100 miles from a primary triangulation station. There will be many parts of the country where the distances to primary triangulation stations will be much less than this.

The Survey must also extend arcs of primary triangulation throughout the area of Alaska, including that portion of Alaska which extends between Dixon Entrance and the head of Lynn Canal, in the vicinity of Skagway. The Geodetic Survey of Canada plans to extend a primary triangulation from the vicinity of the Straits of Fuca to Dixon Entrance and from the head of Lynn Canal to the intersection of the Yukon River and the one hundred and forty-first meridian of longitude. This meridian is the boundary between Alaska and Canada. The Geodetic Survey of Canada and the Coast and Geodetic Survey of the United States would thus cooperate in connecting Alaska and western Canada by triangulation with the primary triangulation of the United States and eastern Canada. A small amount of this Alaska triangulation has already been done, and it is hoped to extend it rapidly in the near future.

For the actual progress of the primary triangulation to date, see figure 53.\* For precise levels needed in Alaska, see figure 28.\*

In addition to the triangulation done by the Coast and Geodetic Survey for the control of maps, surveys, and engineering work of various kinds, it is engaged in extending a network of precise leveling throughout the country in order to furnish to engineers and others accurate elevations on which to base their operations. It can readily be seen that it is as important, in many cases, to know the elevation of a point on the ground or of some object above a certain plane as it is to know the horizontal position of the point or object.

It is especially desirable to know the contour of the ground in laying out drainage and irrigation projects, in extending railroad lines, and in many other industrial and commercial enterprises.

While everyone will agree that it is necessary to know the elevations of the ground in many of our daily occupations, it has not always been recognized as essential to have elevations at each place referred to the same surface or datum. For instance, two cities not very far distant from each other will have different datums on which

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\* Not included in this compilation.

their elevations are based. One may be the surface of a lake near it, the other an arbitrarily assumed elevation for a bench mark. In some cases—in fact, most cases now—mean sea level is used as the datum for elevations. This datum has been universally adopted by the Coast and Geodetic Survey in all of its land operations and also by the United States Geological Survey in all of its topographic work. It will no doubt be adopted in the very near future by all cities, States, and countries, and by private corporations and individuals.

Mean sea level is the only datum that is a universal one; that is, it is the only datum that may be used for many detached pieces of leveling at different parts of our coasts. For instance, mean sea level may be determined at New York City by tidal observations, and elevations may be extended from that point. Likewise, mean sea level may be obtained at Norfolk and levels started from there; also at Galveston and on the Pacific coast, at places like San Diego, San Francisco, etc. There is no limit to the places along the coast at which mean sea level may be determined and be considered as having zero elevations for any line of levels starting inland from them. When leveling has been started at a number of places along the coast and lines extended inland from them, it is reasonably certain that when these lines join in the interior of the country the elevations of a common point, as given by the several lines, will agree almost exactly. Of course such elevations determined will be subject to the unavoidable small errors incident to the precise leveling.

To show the great need for primary triangulation and precise leveling for industrial and economic purposes, there are quoted below portions of letters, pamphlets, and books that have been received at this office from various sources.

A letter from the Director of the United States Geological Survey, addressed to the Superintendent of the Coast and Geodetic Survey, states:

I am pleased to see that the approved estimates for the fiscal year 1913 include an increase for the work of your Bureau in determining geographic positions and more especially because they provide for the extension of a triangulation in Alaska from the international boundary to Bering Sea. I need hardly tell you how valuable the results obtained by the Coast and Geodetic Survey in the States are to this service. \* \* \*

The special purpose of this letter is to direct your attention to the urgent need of a general system of triangulation in Alaska and especially in the Yukon Valley. The accurate location of areas under survey in this northern region will only be possible on the basis of a triangulation. If this is understood now it will settle the problem of location for all time to come. If the triangulation is not made, endless work and much expense will be involved in the adjustment of future surveys and maps.

As the Geological Survey is engaged in the preparation of base maps necessary to the study of the mineral resources of Alaska, it is vitally interested in having the triangulation extended over the more important parts of the Territory as soon as possible. Such a triangulation would also be the first step towards the setting in each mining district of one or more monuments whose positions have been exactly determined. This would give an accurately located tie point for every mineral survey, and by absolutely fixing the position of each survey, would avoid endless disputes in the future. In my opinion great economics will be made in the future by starting this work at once. I therefore urge you to undertake it as soon as means permit.

A report was received at this office giving the results of a triangulation made by a private mining company in Alaska in which a state-



ment was made that it was found necessary for a triangulation to be extended over a certain mining district in order that the initial mineral monuments which had been in general use should have their relative positions determined. It was stated that before the triangulation had been made, there was great confusion in regard to the location of certain mineral claims. When a claim had been located from several mineral monuments, no two locations agreed. When, however, the triangulation had been carried over the area and the relative positions of the initial mineral monuments had been determined, the locations of a claim from several monuments would agree, and there were no confusion and litigation as a result.

Several of the larger cities of the United States, notably New York, Cincinnati, and Los Angeles, have found that it was necessary to extend a primary triangulation over their areas in order that control points might be furnished for the various surveying, engineering and mapping work done within them. It is evident that where such work is done by a city the results should be possible of coordination with maps made by the Federal Government and by the States near them. The only way in which this is possible is for the triangulation to be extended to the vicinity of each of the large cities of the country.

It might be argued that each State should extend its own triangulation within its borders, but when we consider that this would practically mean the organization of 48 geodetic surveys in the country, it is realized that it would be more efficient and cost the people less in the end if a Federal organization should execute practically all of the primary triangulation that is needed by the States and cities. This also applies to a great extent to the precise leveling, and this is largely because, to add to the primary triangulation and precise leveling schemes, lines would have to be added which would lie in several States, in many cases. When the network of arcs of primary triangulation and lines of precise leveling have been extended by the Coast and Geodetic Survey to a far greater extent than is now the case, then it may be best for the States to supplement what has already been done. This is a matter, however, that will adjust itself as the work develops.

The value of primary triangulation in controlling local surveys is illustrated by the experience of the Clinchfield Coal & Coke Co., whose property lies in the States of Tennessee and West Virginia. Extensive plane surveying had been carried on by this company, but it was found that the results were not satisfactory. It was then decided that there should be extended over the area controlled by this company, a primary triangulation to furnish the framework on which detailed topographic and other surveys might be based. The results met fully the expectations of the engineers who planned to have the area controlled in this way.

The State of Massachusetts is now using the triangulation that was executed within its area by the Coast and Geodetic Survey and by the State itself in controlling the surveys of many of its farms. Each farm survey is, if possible, tied into a triangulation station in order that the geographic position of at least one of the boundary corners of the farm may be determined. When a survey of that character is tied into the triangulation, it will be possible to recover

the boundary corners of the farm at any future time, even though all marks defining the boundary on the ground may be destroyed.

It is no doubt true that, in the future, other States will adopt the plan of having farm surveys and other private land surveys connected with the triangulation system of the country.

Triangulation was used by the States of Maryland and Delaware when laying out their oyster beds in the Chesapeake Bay and the Delaware Bay, in recent years. In the report of the Maryland Oyster Survey is the following statement:

There is one point in the methods not adequately explained elsewhere in the publication of the Maryland Oyster Survey which, it is believed, should be emphasized. That point relates to the advantages of the use of geographic coordinates in technically and legally defining boundaries of natural oyster bars and leased oyster bottoms. This method of defining property lines under water was also used in the survey of the leased oyster bottoms of Delaware.

The difficulties of accurately locating and permanently defining the boundaries of a farmer's plantation on land, even with the aid of monuments, public roads, streams of water, and other points of reference, are often great, judging from the disputes arising from this source. But be that as it may, there can be no doubt as to the difficulties of accurately locating and permanently defining the boundaries of an oysterman's plantation situated under the water and at a distance offshore from 1 to 6 miles.

There is only one point on the earth's surface at the intersection of any one parallel of latitude and any one meridian of longitude. Therefore there can be no dispute as to the meaning of such a geographic definition of the location of a point even though all of the original triangulation station marks used in its determination, together with the chart on which the position was originally plotted, have been totally destroyed.

In the case of the destruction of an original triangulation station mark or any other point defined by geographic positions, a competent geodetic engineer can reestablish its exact location by means of a new system of triangulation connected with other distant triangulation station marks which have not been destroyed. In the case of the destruction of the chart on which the position of any such point on the earth's surface was originally plotted, this point can be replotted in its geographic position with any degree of accuracy permitted by the scale of any new chart constructed for that purpose.

If there be no question at the time of the original location and legal adoption of a definition of the location of a point by given latitude and longitude, there can be no technical or legal question afterwards as to its exact meaning, or as to the exact redetermination of the location of this point, be it either on land or water, at its newly determined position or on a new chart in its newly plotted position.

For these reasons the method of defining the location of boundary points by latitude and longitude (geographic positions) was adopted in the survey of the leased oyster bottoms of Delaware. This method is more or less of an innovation in oyster surveys, which was first used in connection with the work of the Maryland Oyster Survey. It possesses so many undoubted advantages and at the same time it is so simple in principle and application when once understood, that its adoption by oyster surveys of States other than Maryland and Delaware seems probable.

The above quotation describes admirably the advantages obtained when oyster surveys are based on triangulation. It may not be quite so simple to apply triangulation to farm surveys because of the obstruction to observations by forests, etc., but it undoubtedly is true that the principle could be used to advantage and profit when lands become valuable as in the case of the State of Massachusetts.

An article entitled, "Expedite the map," by a distinguished geographer of the United States appeared in Science, in October, 1916. In this article it was stated that a committee had been organ-

ized by the writer of the article to expedite the completion of the topographic map of the United States. The article said in part:

Every industry, art, and science which demands a knowledge of the lay of the land is benefited by good maps of the area in which it is carried on. The general location of railways and highways, the planning of water supplies, irrigation and drainage projects, the prosecution of geological, soil, and forest surveys, the development of water powers, and the installation of electric transmission lines, the promotion of large-scale realty transactions, such as are common in less settled parts of the country, are all aided immensely if good topographic maps of their areas are available, and they are correspondingly embarrassed if such maps are wanting. Practical men who have had experience in mapped and unmapped areas can testify to the ease and the difficulty of the work in the two cases.

It is true that maps are needed in all the areas covered by the country for our industry and commerce. Therefore, it would seem to be necessary, in order to mobilize the resources of the country for the purposes of war and peace, that accurate topographic maps should be extended over the country as rapidly as the forces of the Government having such work in charge may be expanded sufficiently to undertake them.

The great need for topographic maps in the commercial and industrial development of the country is shown also by an article which recently appeared in one of the Washington newspapers. It says:

That Uncle Sam's topographic maps are appreciated by public corporations is shown by the fact that telephone companies throughout the United States are constant purchasers. These companies send frequent orders to the Geological Survey, Department of the Interior, for maps in lots of 250 or 500, and occasionally when some big contract has been landed, as many as 1,000 maps are ordered at a time for the use of the engineers and linemen.

Some electric supply companies keep complete sets of the maps of areas in States where they expect to do extended work, and when they hear that contracts are to be let for such work, they refer to these maps and with the "lay of the land" before them, they can tell at a glance the character of the work that may be required and can make their bids promptly and intelligibly.

Telephone officials who are using the maps extensively state to the Survey that they are of indispensable value in their work.

It is no doubt true that the experience of the telephone and electric supply companies is the same as that of many other industrial enterprises and companies. While the Coast and Geodetic Survey does not make the topographic maps in the interior, at the same time the Survey's primary triangulation and precise leveling are needed in order to insure accuracy in the maps in their elevations and geographic positions, and with the primary control as given by the triangulation and leveling, the topographic mapping can be done more expeditiously and at less cost.

A letter received recently from the Director of the Geological Survey gives the following statement:

I wish again to express my thanks to you for so arranging a portion of your field work as to meet the immediate needs of this Survey. The various geographers of this Survey take great interest in watching the progress of the Coast and Geodetic Survey triangulation and precise leveling from year to year and hope to see the plans, as set forth in your annual report and elsewhere, carried rapidly forward to completion.

The results of the triangulation of the Coast and Geodetic Survey are used wherever they are available by the officials of the Federal

Forest Service in locating the boundaries of reservations and other points for which exact positions are needed within the reservations. Letters received from that service by the Coast and Geodetic Survey indicate the extent to which our results are used by their officials.

Triangulation has been used extensively in the Commonwealth of Australia for the surveys of public lands preparatory to their allotment to settlers. It has been impossible in the United States to delay the settlement of public lands until the triangulation could be carried over the areas to be settled, but it is hoped that this may be done in the Territory of Alaska.

In 1912 a conference of surveyors general of the various States of Australia was held at Melbourne. Resolutions were adopted which expressed the opinion of the conference that a geodetic survey of Australia should be undertaken and that such a survey should be conducted by the Commonwealth Government. Among the reasons why such a survey should be made, as expressed by the conference, are the following:

(a) That the system which has hitherto prevailed by which the individual States carried out this work with instruments of varying character, has resulted in divergent standards of accuracy, rendering the work to a great extent unsatisfactory, and though much of it is of high grade, portions of it are impossible of reconciliation and coordination with a continental scheme.

(b) That such surveys are absolutely necessary for the production of accurate maps, will be of high value in connection with cadastral and geological surveys, and form a basis for topographical work for defense and other purposes. It will, moreover, provide a standard of accuracy for surveys of every description throughout the Commonwealth.

(c) That it will afford an invaluable base to which settlement surveys already effected can be connected, providing data for reestablishing boundaries which with increasing density of settlement, becomes a matter of great importance. Further, as regards the sparsely occupied areas of Australia, such a survey if carried out in advance of settlement, will be of the greatest utility and assistance in effecting the settlement surveys which can at any future time be reproduced with a minimum error and at a relatively low cost, preventing litigation consequent upon other methods.

The problem which confronts Australia is identical with that which confronts this country in Alaska, and to a certain extent we have a similar problem in the United States which is to control existing public-land surveys by triangulation.

In a report of the Trigonometric Survey of India of 1905, there is a statement by the superintendent of the value of primary triangulation. He states that the principal triangulation of India was executed for the control of topographic surveys and that its first great practical use has been the prevention of embarrassing accumulation of errors in the surveys at the borders of India. Its second use has been to unify and coordinate all the separate surveys of the various States to give them one origin, combine them into one harmonious whole, get rid of gaps and overlaps from the interior mapping of India, and to free India from the internal boundary disputes that have so troubled other countries. Another use has been to furnish perpetual points for the use of posterity, without which the revisions of maps would be impossible.

The primary triangulation in the United States has been found to be of as great use as that in India although it has not been so greatly extended as in that country. Much more will have to be

done in the United States before we shall have as much triangulation in proportion to our area as India has.

It is most important that primary triangulation be connected with all of the State boundaries in this country in order that there should be known the latitude and longitude of the boundary monuments. This will make it possible to relocate any monuments in the future that may be destroyed, thus avoiding long and expensive litigation over the boundaries of contiguous States.

In one of the best textbooks on higher surveying there is a statement that indicates the great value of the primary triangulation to the Nation. It says in part:

The main object of a geodetic survey is to furnish the necessary control for all other surveys. This control includes the determination of relative positions of a comparatively few widely separated points on the earth's surface and the directions and lengths of the lines joining them. Without such accurate locations the errors of ordinary surveys would accumulate until they vitiated the needed accuracy of the survey and map. Indeed, the primary triangulation of the United States Coast and Geodetic Survey by its corrective functions stands in the same relation to other surveys as the United States Supreme Court stands to all lesser courts. In fact, during the past few years this primary triangulation has been the means of settling boundary line disputes between more than 10 States.

The opinion of the editors of the Engineering News as to the value of precise leveling is expressed by them in a review of a precise leveling report issued by the Coast and Geodetic Survey. This review states, in part:

This is the authority on precise spirit leveling and should be included in the library of every engineer interested in this branch of engineering. \* \* \* The advantages of tying local survey nets into the national precise leveling net is not fully appreciated by many engineers and surveyors, yet it is the only way in which a city datum may be settled once and for all.

The advantages of having precise leveling cover the whole country and of having all the elevations of the country referred to a single surface, which, of course, should be mean sea level, and the disadvantages of not having this leveling and a single surface for reference, are expressed in a number of letters received at this office from prominent engineers of the United States. Extracts from some of these letters are given below.

The chief engineer of the topographical survey commission of the city of Baltimore wrote, in part, as follows:

The city of Baltimore in 1893 established a series of precise level bench marks which have been used since that time in connection with all engineering work carried on by the municipality. This survey has for its datum the mean low tide at Baltimore.

The Pennsylvania Railroad, as well as other organizations, used still a different datum, so one can see that, although the city's precise level work has been carried out to a degree of precision equal to that adopted by your Survey and is satisfactory for all city work, it would have been much better if the datum adopted for Baltimore had been that of mean sea level. This, I am sure, would have been done if at the time this survey was started a Government bench mark had been available. This would, to a certain extent, have done away with certain confusions which now exist.

We believe that the plan for the United States Government to establish bench marks throughout the country, based on mean sea level datum, would encourage the use of that datum by all who wish to carry on any extensive system of leveling and would prove a great convenience and eliminate many errors and much confusion.

The chief engineer of the Chicago & North Western Railway Co. said:

I thoroughly agree with you that this precise leveling is essential in the surveying and engineering work done in this country by various public and private agencies.

We endeavor to base our elevations upon mean sea level wherever possible, but find that the use of various datums by cities, counties, and States results in considerable confusion and arguments. I am of the opinion that if we had but one datum all of our work would be more easily coordinated and would result in less confusion and waste than at present.

The chief engineer of the Missouri Pacific Railway Co. wrote as follows:

It is very desirable, though not absolutely essential, to use one datum plane for all engineering elevations, as with conditions as at present existing there is a great deal of confusion and time lost in looking up proper equations to change from one datum plane to another.

In getting rough approximations of the discharge of streams it is necessary to know the approximate slope, and to get this it is necessary to know the elevations of crossings of the river at different points on its course. Where elevations of these crossings are referred to different datums it is frequently impossible to get more than a very rough approximation of the difference of elevations, which results in a corresponding approximation of the discharge. This also very frequently happens in connection with drainage work.

The use of various arbitrary datums by States, counties, cities, and private organizations is becoming more and more a serious problem, for the reason that it requires considerable research or investigation to determine whether the elevations used are referred to sea level or other datum planes and then to ascertain the correct equations.

I do not know of any one thing which the Coast Survey has undertaken which will be of greater benefit to the engineering profession of the country at large, in so far as all engineering operations are concerned—and by this one can almost say all industrial development of the country—than to promote and secure the adoption of mean sea level as the datum for all elevations.

For the precise leveling already done in the United States by the Coast and Geodetic Survey and by other organizations, see figure 53.

While the principal object of the geodetic work of the Coast and Geodetic Survey is that of furnishing data with which geographic positions and elevations may be determined, at the same time there is another phase of the work that should be mentioned. This is the observations with pendulums to determine the value of the intensity of gravity at places throughout the United States. The value of this work is largely scientific, though it is possible that it may have considerable economic value. Its scientific value consists principally in making it possible to obtain a more correct formula by which the value of the intensity of gravity may be computed at a physical laboratory or some other place where it is desired to know such value. Again, the results of gravity work are of considerable worth in making it possible to study the distribution of materials in the outer portions of the earth. Researches carried on in the Coast and Geodetic Survey in recent years have proved conclusively that under great mountain masses the material in the outer portions of the earth, say, to the depth of 60 miles, is less dense on an average than that of the material in the same zone under the coastal plains. It is also found that the materials at the bottoms of the oceans are, in general, more dense than is the material under the coastal plains. These facts are of great value to geologists and others in what may be called general world science. The subject is a very new one and the Coast and Geo-

getic Survey expects to make many more observations with the pendulum and continue its investigations relating to the densities of the material of the earth. It may be added that it is impossible to tell what is the absolute density of the material at any place down in the earth, but it is possible to arrive at an approximate value of the difference between the actual density and what might be called the normal density.

We may summarize the situation in regard to the geodetic work in the United States somewhat as follows:

The primary triangulation and the precise leveling that have been done are excellent in quality and form the basis from which other primary triangulation and precise leveling may be extended. We should probably have as much more primary triangulation and precise leveling done in the very near future as there is now in existence. It is all the more necessary that this work be extended very rapidly on account of the great development that is going on in the industries and commerce of the country and especially in the extension of its roads, railroads, river control, and other public works. Hundreds of millions of dollars are expended on roads alone each year in the United States. Each road that is built within an area not covered by a topographic map costs more in labor and material than if a topographic map were in existence for the area in question. It may be said that this applies to all extensive pieces of engineering work. In order that the topographic mapping of the country may be done accurately and economically, the primary triangulation and precise leveling should be rapidly extended into those areas that are to be mapped.

The lack of sufficient geodetic work in the form of primary triangulation and precise leveling is not due to negligence on the part of anyone, for it is only recently that engineers and surveyors have recognized the necessity for this geodetic control for maps and engineering work and have made heavy demands upon the Coast and Geodetic Survey to furnish it. With increased demand upon the Survey for this geodetic work it is naturally to be expected that funds will be provided to meet such needs.

This Survey realizes the necessity of publishing the results of its primary triangulation and precise leveling in order that they may be the more readily available for use by engineer, surveyors, and others. It may be said that material which is only in manuscript form is almost as valueless as if it did not exist at all. The members of the Survey who work in the division of geodesy at the office at Washington are almost exclusively engaged upon furnishing information principally to engineers and surveyors who are in the Coast and Geodetic Survey and other Government bureaus and to those in private life. With increased activities in the field in extending primary triangulation and precise leveling there will be needed additional mathematicians and clerks in the office to compute and adjust the field observations and prepare the results for publication.

#### MAGNETIC WORK.

There yet remains a phase of geodetic work which has had no mention—that of magnetic observations. The popular notion is that the magnetic needle always points to the geographical North Pole, while

as a scientific fact, there are fewer places on the earth's surface where it does point directly to the geographical North Pole than where it does not. While the compass needle varies widely from west of north at certain parts of the earth to east of north at other parts of the earth, it is not constant at any place. That is to say, at a locality selected at random, the compass may this year point  $1^{\circ}$  west of north, and a year hence point  $1\frac{1}{2}^{\circ}$  west of north. While the cause of this change is yet unknown, by observations from year to year it has been pretty definitely determined what the rate of these changes are. The information regarding these changes is very essential to the land surveyor. If a survey was made 40 years ago running due north by the compass from a certain mark and the variation of the compass has changed  $2^{\circ}$  to the west since 40 years, if we are going to run a line due north by the compass to-day, we must allow for this deviation of  $2^{\circ}$ . For this reason magnetic observations are made with standardized instruments at selected stations throughout the country to determine what the deviation is at their localities from period to period so that the results may be published for the information of the engineering profession.

While the making of magnetic observations was recognized as one of the functions of the Coast Survey at the time of its reorganization in 1843, it was not until 1899 that it became possible to undertake a systematic magnetic survey of the country. Up to 1877 the magnetic work was confined almost entirely to the coast States and was in most cases executed in conjunction with other branches of the Survey work, and although some observations were made in the interior States in subsequent years, the progress was very slow up to 1899.

The plan for the magnetic survey of the United States, as laid down in 1899, provided for a first general survey with stations 30 to 40 miles apart, to be followed by a more detailed investigation of regions where the general survey indicated irregular distribution of the earth's magnetism. The plan also included the reoccupation at intervals of about five years of a sufficient number of "repeat" stations to determine the change of the magnetic elements with lapse of time, and the operation of magnetic observatories for determining in more detail the changes in the direction and intensity of the earth's magnetic field.

Following this general plan, the distribution of stations has been based largely upon the county subdivision of the States, the idea being to have at least one magnetic station in each county so that the necessary data might be available for the use of the county surveyors in testing their compasses. With this end in view most of the stations have been marked in a permanent manner, and the true bearings of prominent objects have been determined. In many cases meridian lines have been established for greater convenience of the local surveyors.

Observations have been made at all but about 150 of the county seats and a number of areas of marked local disturbances have been examined in more detail. The density of distribution of the stations corresponds in a general way with the density of the population, so that in the unsettled and less accessible portions of the country they are widely scattered, but for the whole United States the average dis-



tance between stations is 25 to 30 miles. About 75 "repeat" stations a year have been occupied. Magnetic observatories have been in continuous operation at Cheltenham, Md., since 1901; at Sitka, Alaska, and near Honolulu, Hawaii, since 1902; at Vieques, P. R., since 1905; at Baldwin, Kans, from 1900 to 1909; and near Tuscon, Ariz., since 1909.

In Alaska the magnetic survey has gone on in conjunction with other branches of the work of the Bureau, so that the observations have been for the most part confined to the seacoast, except for a string of stations along the Yukon River. A general magnetic survey of Porto Rico, Hawaii, and the Philippine Islands has been completed and some observations have been made in Guam and on the Canal Zone.

In the United States proper there still remain many locally disturbed areas which require investigation, the extent to which the investigation should be carried in any particular case being a question which can not be determined in advance. There are other regions where more stations will be required as they become settled. In addition, in order that the accumulated results may continue to be of use, observations at "repeat" stations must be kept up regularly.

Most of the leading nations of the world are cooperating in a study of the earth's magnetism in an effort to determine its origin, the causes of its many fluctuations, and the laws which govern them. In order that accurate data may be available for these investigations, many magnetic observatories are kept in continuous operation recording every change in the direction and intensity of the earth's magnetic field. As the changes are found to be different in different parts of the earth, it is important to have the observatories as widely distributed as possible. The United States, by reason of its wide extent of territory, is very favorably situated for carrying on a large share of this work, and the sites of the five observatories now in operation were chosen with this object in view.

For the success of these investigations it is important that our five observatories should continue for many years, and that in addition observatories should be established on the Canal Zone and on the island of Guam. With these additions we should have a chain of stations extending nearly halfway around the globe, from longitude 65° to 216° west, and extending from latitude 9° to 57° north. These would be supplemented by the observatory near Manila now being maintained by the Jesuits.

## CHAPTER II.

### NEEDS OF THE FIELD SERVICE.

In speaking of the needs of the Bureau with respect to the hydrographic work, so vast is the task remaining to be done and so limited the equipment with which to accomplish it that it is vain to suggest the enlargement and more rapid extension of one phase of the work without a corresponding acceleration of another phase.

I have tried in the preceding chapter to give a clear idea of the condition of the surveys of each section of our coasts, and where and what kind of surveys are urgently needed. Leaving out of the discussion for the present the equipment for surveys in the Philippine Islands, where vessels and funds are supplied in part by appropriations for the purpose by the Philippine Government, this Bureau has for the survey of the Atlantic and Pacific coasts of continental United States, the waters of Alaska, Guam, Porto Rico, Hawaii, Virgin Islands of the United States, and the approaches to the Panama Canal, the following small and more or less superannuated fleet:

#### VESSELS.

1. The *Surveyor*, newly built and just from the shipyard. This vessel is the result of the sum of the past experience of the officers of the Bureau in designing a vessel adapted in every possible way for the attainment of the maximum results with the least expense. She is a steel steam vessel of 1,000 tons displacement; 186 feet in length over all, 34 feet in breadth, 12 feet draft; indicated horsepower 1,000; speed 11.5 knots; fuel capacity 75,000 gallons fuel oil; complement 11 officers and 58 men; built at Manitowoc, Wis., in 1917.

2. The *Isis*. She is a steel steam vessel of 377 gross tons and 256 net tons; registered length 180.4 feet, breadth 24.8 feet, draft 11.7 feet; indicated horsepower 2,000; speed 16 knots; coal capacity 120 tons; complement 8 officers and 44 men. Purchased by the United States Coast and Geodetic Survey July 1, 1915. She was built for a yacht, but was the best adapted for the needs of the Bureau of any vessel on the market at the time funds were available for her purchase, and while not so admirably fitted for the purpose as the *Surveyor*, the money expended for her purchase could not have been better placed for the needs of the Survey.

3. The *Bache*. A composite steam vessel of 472 tons displacement, 370 gross tons, and 252 net tons; registered length 153.2 feet, breadth 26.2 feet, draft 10 feet; indicated horsepower 400; speed 10.5 knots; coal capacity 96 tons; complement 9 officers and 42 men. Built at Shooters Island, N. Y., in the year 1901.

4. The *Explorer*. A wooden steam vessel of 450 tons displacement, 335 gross tons, and 228 net tons; registered length 135 feet, breadth 27 feet, draft 10 feet; indicated horsepower 400; speed 10.3 knots; coal capacity 85 tons; complement 7 officers and 40 men. Built at Wilmington, Del., in the year 1904. In the design and construction of this vessel, it was endeavored to provide for the utmost space in her. To provide this space, some of the strengthening members usually provided in a vessel were omitted. While no weakness was noticed in consequence of the absence of these strengthening members during her earlier work, she is now showing their absence, and in rough seas her sides are pliable to the extent that the bolts holding them together are subject to shearing stresses, and if she is continually employed in rough seas, it means that she will ultimately become too weak to be of any service.

5. The *Hydrographer*. A wooden steam vessel of 146 tons displacement, 116 gross tons, and 79 net tons; registered length 101 feet, breadth 19.5 feet, draft 6.8 feet; indicated horsepower 250; speed 10 knots; coal capacity 22 tons; complement 5 officers and 18 men. Built at Port Jefferson, N. Y., in the year 1901.

6. The *Yukon*. A composite steam vessel of 38 gross tons and 25 net tons; registered length 75 feet, breadth 15.7 feet, draft 5 feet; indicated horsepower 100; speed 7.5 knots; coal capacity 16 tons; complement 4 officers and 13 men.

7. The *Patterson*. A wooden auxiliary steam barkentine of 719 tons displacement, 500 gross tons, and 453 net tons; registered length 163 feet, breadth 27.3 feet, draft 14.2 feet; indicated horsepower 215; speed, steaming, 8 knots; coal capacity 133 tons; complement 12 officers and 49 men. Built at Brooklyn, N. Y., in the year 1882.

8. The *Matchless*. A wooden two-masted schooner of 118 gross tons and 94 net tons; registered length 91 feet, breadth 25 feet, draft 8 feet; complement 6 officers and 16 men. Built at Key West, Fla., in the year 1859.

While we have six so-called steam vessels, one barkentine, and one schooner for surveying the Atlantic and Pacific coasts of continental United States, the waters of Alaska, Hawaii, Guam, Porto Rico, the Virgin Islands of the United States, and the approaches to the Panama Canal, if we examine into the condition of these vessels and their suitableness for the work to be performed, we will find that there is not even strength in numbers.

The *Surveyor* is of course the best-equipped vessel for our work. She is stable enough to work in the most exposed waters and endure the roughest seas and has fuel capacity to enable her to remain at the field of operations for a protracted period.

The *Isis* and the *Bache* are sufficiently seaworthy for offshore work during favorable seasons of the year, but they are hardly staunch enough for making surveys of the exposed waters of California, Oregon, and Washington, and the outside waters of the Alaskan coast. Again, they have not the fuel capacity to make it profitable to employ them on this work, while the *Surveyor* is the ideal in respect to her fuel capacity, using fuel oil instead of coal and therefore being able to remain at sea almost the entire season. With her as a basis of comparison, it is correct to say that for offshore work 20 per cent of

the time of the coal-burning vessels is required to replenish their fuel supply. The percentage of the time lost is of course modified by the locality in which the vessel is working; for instance, if the vessel is working off the coast where there are many supply stations where coal can be secured, not so much time is lost, but if she is working off a coast where supply stations are few and far between, then even more than 20 per cent of time is lost. There is, however, much more of the class of work which the *Isis* and *Bache* are suited to do than can ever be done by them.

The *Explorer*, through the faulty construction mentioned above, is too weak to be exposed to the rough waters of outside surveys and must operate in protected waters.

The *Hydrographer* and the *Yukon* are, of course, too small for any outside work, and they must be employed on inside work in less exposed waters.

The barkentine *Patterson* is structurally too weak to be used in exposed waters and too expensive of operation to be used as a house boat for inside surveys. She has lately been employed in making surveys of the inside Alaskan waters, but is such an antiquated craft that the overhead cost of operation makes the results far less in quantity and more costly than they would be with a modern vessel. The *Patterson* was built 35 years ago.

The schooner *Matchless* was built 58 years ago and of course can serve no purpose now except as a house boat from which parties can operate in making surveys of inland waters.

From the above it will be seen that we have but one vessel (the *Surveyor*) suitable for outside work in all kinds of weather; two vessels (the *Isis* and the *Bache*) suitable for certain outside work but without the fuel capacity of the *Surveyor* and therefore more economically operated in localities where fuel stations are easily available; two small vessels for inside work (the *Hydrographer* and the *Yukon*); one old barkentine, too weak for outside work and too expensive in maintenance to use for a house boat and one old schooner that can only be used as a house boat.

The result is that no concerted scheme of surveying operation for all our waters can be put into effect, but we are compelled to dissipate our appropriations here and there in making needed detached surveys as industry and commerce develop in one section after another of Alaskan waters, or in making examinations here and there for reported dangers.

It therefore follows that the vessels provided are entirely insufficient in number of the various classes to meet the situation at a time when our merchant marine is being enlarged to such an extent that our hydrographic surveys have more attention than at any time in the history of the country.

Considered from the standpoint of insurance, the appropriations expended by this Bureau in providing nautical data for use in making nautical charts is probably the least expensive of any Government venture. During the past fiscal year there were expended by this Bureau in making hydrographic surveys of our Atlantic, Pacific, and Alaskan coasts \$210,410 for field expenses. While over these waters during that period Government statistics show, excluding coastwise

trade, \$8,089,318,107 in value of property carried by water. There are many commercial activities in Alaskan and other waters awaiting the day when we can make the surveys and issue charts containing sufficient data to enable vessels safely to navigate those waters, but until we have the adequate number of vessels and funds for carrying on this work, the full development of the country will be retarded.

#### WIRE-DRAG LAUNCHES.

Something has already been said in this report about wire-drag work, but those remarks were incidental to the discussion of other subjects, and therefore no mention was made of the problem involved in the effort to more efficiently carry on the surveys by this method. However, I did explain the general principles upon which the wire drag is based and how impossible it is to locate all dangers by any other method.

Though it has been used in an earlier publication, it will throw light on the present subject to again print the illustration (fig. 30),<sup>a</sup> representing the wire drag in operation. It was pointed out earlier in this report that by the subsequent use of the wire drag over areas where very close surveys had been made with the lead and line, pinnacle rocks and bowlders were found which only needed a vessel to collide with them to cause a wreck. This, however, was a general statement in connection with remarks on another subject and it may bring the point home more forcibly to cite an instance characteristic of any rocky or coral region.

Prior to 1916 Salem Harbor and approaches (Massachusetts) had been covered by three hydrographic surveys, one in 1850, one in 1858, and one in 1894-5. Then, in 1916 a wire-drag survey was made. While such a subject does not lend itself well to illustration by views, I have tried to show by two drawings just what this wire-drag survey disclosed. One of these drawings (fig. 31)<sup>a</sup> is of Salem Harbor and approaches. On it are shown in red 45 numbered shoals and rocks that were found. Then on the other drawing (fig. 32)<sup>a</sup> I have attempted to show how far below the surface was the bottom of the harbor and approaches as the depths were previously published on our charts, and how much above this general bottom the wire-drag survey showed that these rocks and bowlders really extended. The fact that some of them rise only a short distance above the bottom does not necessarily reduce the hazard involved in their unsuspected existence. If the chart shows 18 feet of water where traffic must pass, and a vessel draws 15 feet of water, then she clears the bottom by only 3 feet. If, then, there is an isolated boulder in this area, though only rising 5 feet above the bottom, trouble is imminent. As stated above, this survey of Salem Harbor is only characteristic of the "finds" of this kind wherever the wire drag has gone.

Figure 33<sup>a</sup> shows all the essential units and members that are required to make up a wire-drag outfit for the coast of New England. It will be noted that four power boats are required.

1. The guiding launch, which is the largest, tows one end of the drag, and determines its course through the water. On this launch

<sup>a</sup> Not included in this compilation.

are carried the machinery for winding in the drag when it is taken up, and the semaphore by means of which all operations are directed.

2. The end launch, which is the next in size, tows the other end of the drag, following instructions signalled from the guiding launch.

3. The large tender patrols the drag when in operation, changing the depths at which the drag is operated, in order to conform to known differences in depth or the rise and fall of the tides, to clear the drag when aground, and to remove lobster pots or other fishing gear in the path of the drag.

4. The sounding tender sounds around and determines the position of menaces to navigation that are found, allows the drag to proceed ahead, and at other times assists in the work of the large tender.

Because of the fact that heretofore there have been no funds appropriated for the purchase of these power launches, they have been rented from private parties.

Now, the purpose of this statement is to show how much more efficiently and economically this work could be carried on if the Government furnished its own launches, designed specifically for this work, instead of following the present practice of renting them from private parties.

Past experience has shown conclusively that the rental which the Government must pay each season for chartered launches amounts to an average of one-fifth of their cost. In other words 5 years rental would purchase the boats outright. As the average life of such launches is at least 10 years, the Government, by building its own boats could get 10 years of service for 5 years rental. This, of course, does not take into consideration the cost of upkeep, but for boats of this character, properly cared for, that cost is trifling, and would be more than offset by other present costs which will be mentioned later.

Launch rentals are high for the following reasons:

1. Owners of launches that have never been used for wire-drag work are unfamiliar with conditions, and have no means of estimating the probable cost of repairs or deterioration.

2. The risk of loss or damage must be assumed by the owner, though he has no voice in the matter of how and when the launches will be used, and insurance rates are high, especially in Alaska.

Heavy-powered, staunch fishing boats are best suited for wire-drag work, and owners of such boats are fairly sure of generous earnings from fishing. Therefore, they will rent only at a figure high enough to insure equal returns.

Launches suitable for wire-drag work are scarce at any price for the following reasons:

1. Pleasure launches usually have enough power for the work, but their hulls are too weak.

2. Fishing and working launches are generally of sturdy construction but are usually low powered.

3. It is impracticable to use launches with two-cycle engines for wire-drag tenders, but launches of a suitable size equipped with four-cycle engines are few in number.

This difficulty in securing suitable launches results in a considerable additional delay and expense. When it is desired to secure the launch equipment for a new season's work it is not sufficient to send out

specifications and proposals to the owners, and when the bids are returned, to examine them and accept the lowest submitted.

Instead, the descriptions furnished must be carefully studied, eliminating those which are clearly unsuited for the intended use, and an officer must then be sent out to personally inspect the remainder and choose the ones which afford the most advantageous combination of adaptability and low rental.

Finally, it is never possible to secure launches suited in all respects to the work. Alterations, more or less extensive, must invariably be made. These alterations are those necessary to strengthen the decks sufficiently to carry the weight of the heavy machinery and gear, to provide for the installation of the auxiliary engines, reels, signalling system, etc., used, to clear away rails, awnings, and obstructions on deck, and to suitably protect woodwork or fittings from damage in the handling of heavy buoys or weights. All expenses so incurred must be borne by the Government, and at the end of the season they must be duplicated in restoring the launch to its original condition.

These extra expenses of inspection and alteration would more than pay for the upkeep of Government-owned launches.

For example, the yearly average cost to the Government for installing the wire-drag machinery on the rented launches and removing it at the close of the season, taking into consideration the time of the field officers utilized for this purpose, was, for each of the four parties in the field, about \$850, or a total of \$3,300.

There is this further thing to be said about renting launches for wire-drag work. There are localities in which the wire-drag work must be done where launches can not be hired for the purpose because they are not there to be hired. This is true of Porto Rico. Likewise, the few launches available in the region of Key West are wholly unsuited for wire-drag work.

While this report was being prepared, there has been received from the Secretary of the Navy a letter as follows:

NAVY DEPARTMENT,  
*Washington, September 26, 1917.*

SIR: I have the honor to forward herewith a paraphrase of a cablegram received from the governor of the Virgin Islands of the United States relative to the inquiries contained in your letter of 6 September:

"It is recommended that a wire-drag survey be taken of the waters between the Islands of St. Thomas and St. John in addition to the vicinity of Vieques Sound. It is regretted that there are no motor boats available in this locality for this work. The general conditions of St. Thomas and St. John are mountainous, rugged, dense undergrowth, sloping, thinly populated, and arid. In connection with the topographical survey, the location of property boundaries is most important. It is also recommended that a geological survey, with special reference to the location of suitable sites for artesian wells, be made."

The Navy Department regrets that there are no boats available for assistance in the making of this wire-drag survey, but should a vessel be stationed in that vicinity which carries appropriate boats for this service, orders will be issued for her to assist in every way possible.

The Department will be pleased to be informed as to the action taken relative to the survey of these islands, and to assist in any manner which may be possible.

Sincerely yours,

JOSEPHUS DANIELS.

The honorable the SECRETARY OF COMMERCE.

To this letter reply was made as follows:

DEPARTMENT OF COMMERCE,  
OFFICE OF THE SECRETARY,  
September 29, 1917.

SIR: The receipt of your letter, dated September 26, 1917, relative to surveys in the Virgin Islands, is acknowledged.

I regret to learn that the Navy Department will be unable to furnish the necessary launches for the wire-drag work in the vicinity of the islands of St. Thomas and St. John and Vieques Sound, as it is understood that no suitable launches can be obtained locally for this work.

Under these circumstances, it appears that the hydrographic work in general will necessarily have to be postponed until the return of the Coast and Geodetic Survey vessels from duty under the Navy Department or until suitable launches can be obtained from other sources.

As stated in previous correspondence from the Coast and Geodetic Survey, officers and equipment for the shore work of the survey of the islands will be sent to St. Thomas at the earliest practicable date. They will be instructed to use any of the small launches that may be found suitable for the local hydrography, upon arrival in the islands, and it is probable that the hydrographic surveys of the bays and harbors can be made during the winter.

Respectfully,

WILLIAM C. REDFIELD.

The SECRETARY OF THE NAVY,  
Washington, D. C.

In concluding this matter, I can not better express conditions than to quote from a letter just received from one of our engineers in charge of a wire-drag party that has this season been operating in the vicinity of Key West, Fla.:

According to all reports we have been fortunate in having an unusually favorable season for work but I am afraid that it is about over, for heavy squalls and rain are beginning to make things interesting and the weather seems to be getting generally unfavorable.

It would not be so bad if our end launch could only take care of herself, but it is asking almost too much of a 25-horsepower guiding launch to take up the drag in a heavy squall, that may last five minutes or five hours, and then get a line to the end launch and furnish enough power to give her steerage way.

I wish that the opponents of Government-owned wire-drag boats could have spent the season with us and personally experienced the constant annoyance and obtained an idea of the inefficiency of the present system of chartering boats, especially in regions where suitable launches are few and far between. I believe that this is the first wire-drag work that has been done almost entirely out of sight of land and in what, because of strong currents, is even worse than the average open sea; and it has been necessary to do it with launches that we would hardly consider adequate for work in Cape Cod Bay.

In the four months of actual field work to date we have covered about 225 square miles. Our guiding launch is the most able sea boat for her size that I have ever seen and I am sure that, with an end launch that could even equal her power and slow speed of 6 or 7 knots, we could easily have covered 100 square miles more.

Of course the present conditions and demands of the Navy for numerous motor boats have increased our difficulty in obtaining suitable launches but they are not too plentiful in this region at any time.

#### NEED AND IMPORTANCE OF CURRENT OBSERVATIONS.

Earlier in this report I described the nature of the data that must be gathered by the Bureau to enable it to furnish predictions of the currents, and the reasons why a special arrangement was necessary before such data for the outside coasts could be secured in adequate amount and at reasonable cost.



In this chapter it is my purpose to explain the importance of securing more information regarding ocean currents and to make a plea for authority to expend funds for that purpose in a manner that will secure the best results with the least expenditure of money.

I have explained how it is possible through hourly current observations made at different lightships maintained by the Bureau of Lighthouses on the Atlantic, Gulf, and Pacific coasts to obtain data which would be basic for the localities where the lightships are stationed and the more valuable because these lightships are generally stationed near the tracks of marine commerce, and therefore, if the data obtained from current observations at these ships do not form the premises from which other conclusions can be drawn, they would be of the utmost importance as a basis for predictions in the localities where the lightships were stationed. However, based on our present knowledge of current phenomena there is no hesitation in making the assertion that hourly current observations made at advantageously located lightships would form a basis that would go far toward solving the problem of current predictions.

If, then, these current observations at lightships will result in such beneficial data, the question may rightly be asked, why are not these observations made? The reasons are that the funds available for carrying on the work of the Coast and Geodetic Survey under the wording of the present appropriations can not legally be expended to remunerate the crews of these various lightships for making these observations; that the employees on the light vessels will not, nor should they, be expected to make the necessary continuous day and night observations without being compensated for so doing, and that it is impracticable to station on the light vessel extra men employed for this specific duty. I am advised by the Commissioner of Lighthouses that as the crews of the various lightships are only paid fair wages for the services they now perform, it is extremely difficult to keep men in the service. It would be not only unfair to impose the extra duty of making these observations on the crews of the lightships without extra pay for the services but, if this were done and the observations were made indifferently and without a spirit of cooperation, the results would be unreliable, and predictions made from them might be so wholly erroneous as to be harmful rather than helpful.

This matter has had deep consideration both by the members of this Bureau and by the officers of the Bureau of Lighthouses, and the following plan is looked upon with favor by all concerned, namely, to pay out of the appropriations for the Coast and Geodetic Survey into the mess fund of each lightship where current observations are made \$1 for each day that observations are made. Under existing laws there is a prohibition against such a method of carrying on this work, and it would require a provision in the bill making appropriations for the Coast and Geodetic Survey authorizing such payments before this could be done. It would thus cost but \$365 a year to make continuous hourly current observations at any selected lightship, and there is every reason to believe that by such cooperation the results would be reliable.

The question may now have arisen as to whether these current data are really of more than theoretical importance. To show that they

are of practical importance, I could cite numerous instances where wrecks have been the result of the lack of knowledge of the direction and strength of currents, but shall confine myself to two:

The steamer *Lugano* was at a point  $2\frac{1}{2}$  miles off Great Isaac Light at the northern extremity of the Bahama Islands, bound for a port in the Gulf of Mexico. Figure 34<sup>a</sup> shows, by a blue line, the track which the master laid down on the chart for his vessel to follow and which he actually believed it was following. No allowance was made for the northerly set of the vessel due to the Gulf Stream, however, and as a result the vessel was wrecked on Long Reef,  $17\frac{1}{2}$  miles north of her supposed position. In other words, the vessel, instead of following the track as shown in blue, had actually followed the track shown in red.

As the vessel was  $7\frac{1}{2}$  hours making this run, and during that time was set  $17\frac{1}{2}$  miles off her course, it follows that the average velocity of the current to which she was subject was  $2\frac{1}{2}$  miles per hour; but as these velocities vary greatly for different parts of the Gulf Stream, it is probable that during part of the run she was subject to a current of at least 3 knots.

A case of even greater interest, since it illustrates not only the disaster which may occur from a lack of current predictions but, also, the way in which lack of adequate surveys may contribute to such losses, is that of the steamer *Bear* which, in June, 1916, stranded on the coast of California and became a total loss.

The *Bear* was bound from the Columbia River to San Francisco. The weather was foggy; since passing Cape Blanco, 10 hours before the disaster, they had been unable to see the land and determine their position. Therefore, as they approached Cape Mendocino they began to take soundings to locate the position, using the method described earlier in this report.

In this locality the danger line is the 30-fathom curve. Figure 35<sup>a</sup> shows that according to the chart, if a vessel keeps in depths of 30 fathoms or more, she will be in no danger. In fact, it is a common practice for vessels in this locality, uncertain of their position, to feel their way carefully in to a depth of 30 fathoms and then follow that depth, which leads within easy hearing distance of the fog signal on Blunts Reef Light Vessel. When they hear that signal they knew where they are and can proceed with confidence.

When they began sounding they were in deep water. They let out 1,200 feet of sounding wire without reaching bottom, which meant that they were in depths of over 100 fathoms, or, according to the chart, somewhere outside the 100-fathom curve. They took a number of such soundings, no bottom at 100 fathoms. Then they got bottom, about 80 fathoms. They felt their way along, sounding as they went, getting bottom in depths which shoaled gradually from 80 to 34 fathoms. In other words, according to the chart they were always outside their danger line, the 30-fathom curve.

The next sounding reported again gave deep water—80 fathoms, and after that no bottom at 100 fathoms. According to the chart, there was only one place where such a series of soundings could have been obtained. The vessel must have crossed the shoal plateau which extends westward from Cape Mendocino and entered the deep sub-

<sup>a</sup> Not included in this compilation.

marine valley which makes in toward the beach about 3 miles southwestward from the cape.

In other words, the vessel must safely have passed the dangerous reefs off Cape Mendocino. The commander assumed that such was the case, and changed his course for Point Arena. About an hour later the vessel stranded near the mouth of Bear River, 2 miles northward of the cape. Instead of following, approximately, the track shown on the chart in black, it had actually followed the one shown in red.

Here is a disaster which cost six lives and a vessel valued at \$1,000,000, which occurred as a direct result of the navigator not having the information essential to the safety of his passengers, his ship, and himself. It is true that the official investigation of the disaster proved that the officers in charge had been guilty of what might be called contributory negligence and that had it not been for such negligence the disaster might not have occurred.

However, it is just this information of the currents and the ocean depths, which this navigator did not have, that should be obtained and put in practicable form as soon as possible so that navigation may be adequately safeguarded and the recurrence of such fatalities prevented.

#### CREWS OF VESSELS.

Another need in connection with the hydrographic work is to remedy the situation with regard to crews on the vessels of the Coast and Geodetic Survey, which has long been a serious one and this year became so acute that a number of the vessels had to be laid up as a result of the impossibility of getting and keeping sufficient men to enable them to operate efficiently.

The conditions of labor in the United States have undergone an enormous change in the past few years. Labor has demanded and received higher wages and better working conditions. The Coast and Geodetic Survey, however, among other Government institutions, has been unable to keep pace with that change, and the result has been that just in proportion as it failed to do so its efficiency has been reduced.

There are a number of factors which make service in the Coast and Geodetic Survey undesirable from the point of view of the enlisted man. The pay is less than he can earn elsewhere, either in the merchant marine or in various industries ashore; the work is of more than average difficulty and must sometimes be continued through much longer hours than the 8 to 10 hours to which he is accustomed elsewhere; the living conditions in the crowded forecables of small and antiquated wooden vessels are anything but attractive; and, finally, his employment is only temporary and may be terminated at any time, so that he has not even the incentive of a permanent position to compensate him for the other undesirable features enumerated.

The result of these conditions is that the Coast Survey has earned the reputation, among seafaring men, of being an undesirable service. Men will come to it only as a last resort, when out of work, out of money, and with no chance to find employment in other lines of work.

This means, of course, that the Survey gets the most undesirable type of men on the water front—the misfits, those who in the process of selection have been refused for other more desirable occupations.

Such men seldom remain on one job long enough to become of value. When they have earned a few dollars they want to quit; if they can not obtain their discharge upon request, they either desert or by refusing duty, drunkenness, and general misconduct compel the commanding officer to get rid of them.

The constant change and upheaval in the crews which result from these conditions are strikingly portrayed in the following table, which shows for each Coast Survey vessel in the United States waters the complement allowed and the number of persons in the complement during the fiscal year, 1917:

Vessel.	Station.	Complement.	Persons in complement.
Surveyor.....	Atlantic coast.....	58	a 85
Beche.....	do.....	42	120
Isis.....	do.....	44	171
Matchless.....	do.....	16	54
Hydrographer.....	Gulf coast.....	18	51
Patterson.....	Pacific coast.....	49	b 132
Explorer.....	do.....	30	b 124

a In commission only since June 11, 1917.

b In commission only about seven to eight months of the year.

Even this table does not tell the whole story, as there is not one of these vessels which has not been continuously shorthanded, through inability to obtain recruits.

These factors, the undesirable type of men which alone can be obtained and the inability to keep men even of this type, result in a great loss in efficiency.

The Coast Survey ships, as surveying units, are carefully planned, and their equipment and personnel are arranged so as to provide for the most efficient and economical operation of three to five surveying parties. In these parties the enlisted men form an integral part. They are not there merely to man the ship; they take an active part in the surveying work. They are the recorders, rodmen, leadsmen, tide observers, coxswains or engineers of the surveying launches, operators of the sounding machines, etc. There are no idlers or supernumeraries; each man (with the possible exception of the mess force) has his definite place in the organization, and so the shortage of a single man means a loss in efficiency, while a shortage of three to five men means that one less party can be worked. This means that in return for the saving in the wages of these men (a negligible quantity) the efficiency of the vessel, which must be measured by the amount of work accomplished, is reduced from one-third to one-fifth.

It costs from \$30,000 to \$60,000 a year to operate one of these ships, depending on size and location, and it follows that a shortage of a few men in the complement will, for a ship engaged in combined operations, result in a loss of \$6,000 to \$20,000 a year.

Losses occur as a result of the lack of training of the men in the specialized work which they are required to perform. The enlisted

men in the Coast Survey require such training quite as much as do the men in the Army or Navy. As already indicated, in the former service these men do not merely shovel coal, scrub decks, or clean brass; they take an active part in the surveying operations, only a little less important than that of the officers, and no amount of efficiency on the part of the officers can compensate for their failure to perform their work properly. In these days of increased draft, ships must pass close to the bottom, particularly along the Atlantic coast. The officers may properly find and locate the channels or shoals, but if the leadsman does not read the depths correctly, if the recorder does not record them properly, or if the tide observer goes to sleep or goes off somewhere for the day and then "fakes" the record of his staff readings, the result may be the loss of a vessel through an error in the chart.

At least a season's work is necessary to properly train these men in such duties. Yet, the record of changes in complement above quoted shows that the complements change on an average of two to three times a year. Furthermore, the men that present conditions enable the Survey to obtain are, as a rule, of a type that have no desire to become proficient in the work. Their thoughts center on spending their pay, not on earning it fairly, so that too often their efforts are concentrated on performing the minimum amount of labor that can be forced out of them.

Losses occur as a result of the effect of these conditions upon the officers. Officers, who year after year are compelled to operate under such discouraging conditions, who are continually harassed by their inability to obtain good men or to enforce discipline over bad ones, and who have appealed to the office again and again for relief, without obtaining it, become discouraged and lose their enthusiasm and ambition for accomplishment. Inevitably, they come finally to take things easy, to humor the crews, to making concessions before an issue is forced. Their first thought is not the accomplishment of the work with which they are charged but rather to so operate as to avoid a rupture which they are powerless to control.

It must be clearly understood that these conditions are not merely the result of the present world conflict. They existed in a serious degree before that conflict began, and the war has merely exaggerated them to such an extent that, as already stated, it has become necessary to lay up certain ships which could no longer be operated efficiently.

An effort has been made to compute the cost of these losses in efficiency, and from the best data available it appears that the loss by the seven vessels operating in the United States during the past year is about \$82,000. One case, that of the *Patterson*, may be cited as typical.

The *Patterson* works in Alaska in the summer, and winters in Seattle. Last spring she was detained 20 days in Seattle through inability to obtain men. She finally sailed with a shortage of 5 men. After working for about 6 weeks with this reduced complement and its resultant loss of efficiency, the ship was compelled to go to port. Here 5 days were lost through drunkenness among the crew and their refusal of duty. She finally got away with a shortage of

7 men. Efforts to recruit men in Seattle to fill these vacancies were unavailing; men would not consider the \$60 a month offered when they could readily earn \$100 or over elsewhere.

Work was continued with this reduced complement, therefore, until early in August when the situation was relieved by discontinuing the work of another vessel, the *Explorer*, which had been operating under conditions equally unsatisfactory. Enough men were kept aboard the *Explorer* to bring her to Seattle, where she was laid up; the remainder of her crew was transferred to the *Patterson*.

The estimated cost of this decreased efficiency on the *Patterson*, alone, is \$24,500.

All possible means have been used by the Survey to improve these conditions. The pay of the crews has been increased to an amount considerably beyond that available under the existing appropriation. If the ships were operated during the 1918 fiscal year on the same basis as they have been for some years past, there would be a deficiency of \$30,000 in the appropriation for pay of crews. The fact that officers and vessels of the Survey have been taken over by the Navy relieves the situation; otherwise, it would have been necessary either to obtain a deficiency appropriation from Congress, or to lay up at least part of the ships in the spring of 1918.

For this situation there are two possible remedies, one partial and one complete.

The partial remedy is to allow the present status of the crews to remain unchanged, employing them for the duration of the season, and paying them a wage as high or slightly higher than they would obtain elsewhere.

This plan, in a modified form, has already been adopted by the Bureau, and in the 1919 estimates the fund for pay of crews is based on the wage scale recently adopted for the governmental and private merchant fleets by representatives of the Department of Commerce, the Department of Labor, the Shipping Board, employers, and employees.

There are, however, a number of reasons why this increase in wages will not completely solve the problem under consideration.

1. The equality in wages is only apparent, for the earnings of merchant seamen are materially increased by overtime pay, which it is impracticable to grant employees in the Coast and Geodetic Survey.

2. The Survey vessels, working near ports, must compete not only with the merchant marine but also with the labor markets ashore. These latter are glad to pay \$75 to \$100 per month for the men to whom the Survey can offer only \$60.

3. Employing men for the season only, even if they could be induced to remain for that period, will not afford a complete solution. As has already been shown, the maximum effectiveness in the work of the Survey can be obtained only with trained crews. It requires a season to train these men, and under the above plan they would be discharged just when they were beginning to be effective and the following season the same training process would be begun anew.

The truth is that increased pay is only one element entering into the final solution of the problem. The final solution rests on a complete readjustment of present conditions.

The men must eventually be given permanent employment at a fair wage and under comfortable living conditions. They must have before them some prospect of advancement for faithful service, and their rights must be fully safeguarded. In return, they must be required to live up to the terms of an equitable contract, and there must be authority for dealing effectively with the occasional undesirable who refuses to do so.

Such a readjustment will make it possible to build up a permanent organization of sober, industrious men, devoted to the Survey and its interests through long association, and will result in an increase of 20 to 25 per cent in the efficiency of every vessel.

## **Part II.—WORK AND NEEDS OF THE WASHINGTON OFFICE.**

### **CHAPTER I.**

#### **WORK OF THE WASHINGTON OFFICE.**

Last year, in my annual report, I gave a synopsis of the duties of the various divisions and sections of the Washington office of this Bureau; and as the organization and duties have remained the same, though there have been a few changes in the personnel, it is unnecessary to again enumerate their duties, but I will state in general terms the nature of the work of the Washington office and then more particularly what each division and section has accomplished.

In addition to the administrative direction of the work of the Bureau being centered at the Washington office, it is the repository for all original notes, survey sketches, and books of record made in the field, whether on land or at sea, in the process of carrying on the surveys which it is the function of the Bureau to make. It is through this office that data from these surveys are handled and finally issued in the form of charts, tide tables, coast pilots, magnetic tables, and special publications containing geodetic and other information of value to the navigator and the engineering profession.

It would not be of general interest to give in detail all the activities of the different divisions and sections of the office in compiling, drafting, computing, preparing for printing, printing, and in carrying on correspondence incident to the issuing of the charts and publications of this Bureau, but it seems well to show a comparison of this year's issue of charts and coast pilots with that of last year and previous years, and for the purpose of record to give a résumé of the accomplishments of each of the divisions of the office.

A brief summary of the work accomplished by the different divisions of the office during the fiscal year is as follows:

#### **OFFICE OF THE HYDROGRAPHIC AND GEODETIC ENGINEER IN CHARGE OF OFFICE.**

General routine office work incident to the maintenance and upkeep of the buildings occupied by the Bureau. In this connection, the old boilers that supplied heat for the buildings, and which had been condemned by inspectors under the Engineer of the United States Navy Yard, were removed and two new boilers installed. Extensive improvements were made throughout the various sections of the office in an effort to place them in a sanitary and orderly condition, in order to fulfill the requirements of the Public Health Service.



Under a rearrangement of the sales office, bookkeeping room, chart-correcting room, and the printing rooms the transaction of business has been greatly facilitated. The production of charts has been greatly increased by printing a large number of them by lithography rather than from the engraved copper plates. Receipts from the sale of charts and publications, etc., during the year were \$21,018.58.

A new spring balance for applying the exact required tension to invar base tapes in measuring primary base lines was designed, as was also a new sounding tube.

During the fiscal year 1,668 instruments, apparatus, tools, etc., were repaired in the shops; 1,534 instruments, apparatus, tools, etc., were made, and 707 instruments purchased.

Instruments shipped to the field during the year	3, 790
Instruments received from the field during the year	2, 545
Articles of general property shipped to the field during year	6, 717
Articles of general property received from field during year	1, 257

The expenditures for the purchase of items of various kinds for the office amounted to \$89,985. By improving the methods of handling this business, the section handling the expenditure of these moneys has been able, though short handed, to keep pace with the needs of the Bureau. The war situation has made very difficult the purchasing of supplies. Delinquency on the part of contractors in the delivery of supplies is becoming more and more frequent, thus necessitating extra work and correspondence.

During the year 58 new original topographic sheets and 70 new hydrographic sheets were added to our archives, as were also numerous original records made during the course of surveys in the field. These were all properly accessioned and filed for future reference.

#### DIVISION OF GEODESY.

The most important pieces of work which were completed during the past fiscal year or which were in progress during that time are the following, some of which may have been begun during the previous fiscal year:

Computation and adjustment of the following pieces of triangulation: (1) The triangulation which controls the survey of the Maryland Shellfish Commission; (2) along the coast of Maine; (3) Utah-Washington arc of primary triangulation; (4) Lake Washington and Seattle; (5) ninety-eighth meridian south, connecting with Mexican triangulation; (6) St. Vincents Sound, Fla.; (7) Boston Bay, Mass.; (8) along the coast of Georgia; (9) Tampa Bay, Fla.; (10) Pasquotank River, N. C.; (11) Lake Borgne and Lake Pontchartrain, La.; and (12) in Rhode Island.

The field computation was made of the following pieces of triangulation: (1) Arthur Kill, N. J.; (2) in the District of Columbia and suburbs, for the Washington Suburban Sanitary Commission; and (3) Memphis-Little Rock (traverse).

The computation and adjustment of the following lines of precise leveling: (1) In Michigan and Indiana; (2) from boundary to Vanceboro, Me.; (3) from Clovis to Pecos, Tex.; (4) from Cedar Keys, Fla., to Birmingham, Ala.; (5) from Washington, D. C., to Indian Head, Md.; and (6) from Birmingham to Mobile, Ala.

The computation of azimuth, the observations for which were made by Hydrographic and Geodetic Engineer C. V. Hodgson in 1915-16.

The computation of latitude and longitude, the observations for which were made by Hydrographic and Geodetic Engineers J. E. McGrath and W. B. Fairfield in 1916.

The computation of various latitudes, the observations for which were made a number of years ago.

The computation and adjustment of latitude and longitude for Rochester, N. Y., the observations for which were made by Hydrographic and Geodetic Engineer C. H. Sinclair.

The computation and adjustment of observations for the determination of the intensity of gravity at a number of stations established by Messrs. Garner and Steinberg.

#### DIVISION OF HYDROGRAPHY AND TOPOGRAPHY.

In this division was planned the details of carrying on the hydrographic work and preparing instructions to the various field parties for its execution. This included instructions to the parties on the various vessels of the Bureau, the wire-drag parties, and the revision parties.

In respect to the locality where the work has been done, investigations have been made with regard to the different existing surveys, the character of the locality, the nature of the bottom, and the required closeness of the work to be done. By a careful study of conditions surrounding the area to be surveyed, and reviewing former survey records, data and results were placed before each chief of party that assisted him to efficiently direct his operations.

The office work of this division further consisted of reviewing and passing upon the plans and specifications of the new vessel of the Bureau, the *Surveyor*, which has recently been completed. Repairs to vessels have also been supervised from this division.

Two coast pilots and one inside route pilot were prepared for the printer during the year; also, the tide tables for 1918.

#### DIVISION OF CHARTS.

The following statistics show the accomplishments of this division in the way of drafting, engraving, and photographic work for the past year, as well as the accomplishments for 1913, 1914, 1915, and 1916:

Work done	1913	1914	1915	1916	1917
<b>DRAFTING.</b>					
Schemes approved for new charts.....	15	20	18	4	8
Approved schemes on hand, charts not started.....	5	4	11	5	5
Drawings for new charts finished.....	23	18	18	4	11
Drawings for new charts in hand.....	13	16	8	10	10
New drawings for new editions finished.....	5	7	4	10	11
New drawings for new editions in hand.....	2	.....	6	10	4
Extensive corrections finished.....	121	87	137	157	151
Extensive corrections in hand.....	5	9	18	11	14
Chart drawings from Manila, for new charts finished.....	12	8	3	2	3
Chart drawings from Manila, for new editions finished.....	1	10	4	5	14

Work done.	1913	1914	1915	1916	1917
<b>ENGRAVING.</b>					
New plates for new charts finished.....	9	6	3	2	8
New plates for new charts in hand.....	10	7	12	11	6
New plates for former lithograph charts in hand.....			1	3	2
New bassos for new editions finished.....	15	18	19	11	15
New bassos for new editions in hand.....	14	13	16	16	3
New editions using current plate finished.....	21	14	18	24	33
New editions using current plate in hand.....	2	6	4	2	2
Extensive corrections applied to plates.....	268	239	286	316	269
Extensive corrections applied to plates in hand.....	13	9	11	14	7
Miscellaneous plates engraved or corrected.....	8	11	11	22	21
Minor corrections applied to plates.....	1,315	1,198	1,245	1,158	696
Charts in section, engraving not started.....	2				
<b>PHOTOGRAPHING.</b>					
Glass negatives made.....	992	1,184	1,189	1,226	1,109
Paper negatives made.....	32	30	9	11	
Vellox prints made.....	1,215	1,903	1,963	4,313	3,413
Vandyæ prints made.....	135	244	64	52	36
Bromide prints made.....	340	317	259	500	361
Blue prints made.....	2,123	1,937	3,127	2,411	1,921
Photostat prints made.....	11,240	11,381	15,224	18,549	19,017
Lantern slides made.....	1	11	172	364	206
Matrices made.....	74	101	90	43	96
Redeveloped prints made.....					197
Prints mounted.....	23	19	18	30	63
Negatives developed.....	6			22	41
Photolithograph negatives, number of charts.....	76	52	49	30	29

#### DIVISION OF TERRESTRIAL MAGNETISM.

The office work accomplished by this division during the year is as follows:

The results of field work executed during 1916 were computed and prepared for publication as Special Publication No. 42.

Magnetic Tables and Magnetic Charts for 1915 was completed and submitted for publication as Special Publication No. 44. It contains the latest values of declination, dip, and horizontal intensity for all places in the United States and adjacent foreign countries at which magnetic observations had been made up to the end of 1915, together with corresponding reduced values for January 1, 1915; tables used in reducing the results to 1915; tables giving the values of the magnetic elements and components for each full degree of latitude and longitude in the United States; maps showing the lines of equal declination, dip, horizontal intensity, vertical intensity, and total intensity as well as lines of equal annual change of the first three.

The reduction of the observations made at the five magnetic observatories during 1915 was completed and progress was made with the 1916 observations.

The earthquakes recorded at the five magnetic observatories have been tabulated monthly and the results have been published in the Monthly Weather Review, and transmitted to the International Seismological Association and others engaged in a comparative study of earthquake data.

Observatory data for August 26, 1917, were prepared at the request of Prof. R. F. Stupart, to be used in a study of the severe magnetic storm which accompanied the auroral display of that date.

An isogonic chart of the State of Washington and a collection of the results of declination observations in that State were prepared

for Henry Landes for publication in a geographical dictionary of the State.

A table giving the values of the magnetic declination at numerous places in the United States for 1917 was prepared for insertion in the World Almanac.

The results of magnetic observations along the forty-ninth parallel Canadian boundary were tabulated for publication with the report of the Boundary Survey.

Compass data were supplied for 146 charts.

#### ISSUE OF CHARTS AND COAST PILOTS.

Figure 36\* shows graphically how the issue of charts has increased. In actual figures, the number of charts issued during the fiscal year 1916 was 158,303, while the number issued during the fiscal year 1917 was 203,506.

Figure 37\* shows graphically how the issue of coast pilots has increased. The number of coast pilots issued during the fiscal year 1916 was 5,602 while the number issued during the fiscal year 1917 was 7,935.

#### PUBLICATIONS ISSUED DURING THE YEAR.

Serial 32. United States coast pilot, Atlantic coast: Section C, Sandy Hook to Cape Henry, including Delaware and Chesapeake Bays. 284 p., 1 map. 8vo.

Serial 33. Results of observations made at United States Coast and Geodetic magnetic observatory at Vieques, P. R., 1913-14; by Daniel L. Hazard. 102 p., 7 charts. 4to.

Serial 36. Results of magnetic observations made by United States Coast and Geodetic Survey in 1915; by Daniel L. Hazard. 80 p. 4to.

Serial 42. General tide tables for 1917. 489 p., 13 text fig. 8vo.

Serial 43. Atlantic coast tide tables for eastern North America, 1917. 195 p., 13 text fig. 8vo.

Serial 44. Pacific coast tide tables for western North America, eastern Asia, and many island groups, 1917. 144 p. 8vo.

Serial 45. United States coast pilot, Atlantic coast, section E, Gulf of Mexico from Key West to Rio Grande. 169 p., 1 map. 8vo.

Serial 47. Elements of chart making; by E. Lester Jones, Superintendent. (Special publication 38.) 15 p., 20 pl., 12 charts. 8vo.

Serial 48. Supplement to regulations and instructions, January 1, 1913-June 30, 1916. 20 p. 8vo.

Serial 49. Precise leveling from Reno to Las Vegas, Nev., and from Tonopah Junction, Nev., to Laws, Cal.; by H. G. Avers and G. D. Cowle. (Special publication 39.) 49 p., 5 text fig. 8vo.

Serial 50. Investigation of gravity and isostasy; by William Bowie. (Special publication 20.) 196 p., 1 pl., 4 p. of pl., 9 charts in pocket. 4to.

Serial 51. Supplement to United States Coast and Geodetic Survey catalogue of charts, coast pilots, and tide tables, 1916. August 30, 1916. 6 p. 4to.

Serial 52. Inside route pilot: New York to Key West. 3d ed., September 15, 1916. 94 p., 8 litho. 8vo.

Serial 53. Rules governing the issue of original sheets and records. 2 p. 8vo.

Serial 54. Supplement to United States Coast and Geodetic Survey catalogue of charts, coast pilots, and tide tables, 1916. January 2, 1917. 7 p. 4to.

Serial 55. Supplement to regulations and instructions for government of United States Coast and Geodetic Survey. 9 p. 8vo.

Serial 56. Supplement to third edition United States coast pilot. Atlantic coast, part III, from Cape Ann to Point Judith, February 1, 1917. 21 leaves. 8vo.

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\* Not included in this compilation.

Serial 57. Supplement to United States coast pilot, Atlantic coast, parts I-II, March 9, 1917. 13 leaves, 8vo.

Serial 58. Supplement to United States coast pilot, Atlantic coast, section D, March 16, 1917. 22 leaves. 8vo.

Serial 60. Use of mean sea level as the datum for elevations; by E. Lester Jones, superintendent. (Special publication 41.) 21 p. 8vo.

Annual Report of Superintendent, 1916. 164 p., 20 litho., 33 pl. [Printed also as H. doc. 1489, 64th Cong., 2d sess.] 8vo.

Centennial celebration of United States Coast and Geodetic Survey. 196 p., 42 text fig., 3 pasters. 4to.

Supplement to United States coast pilot, Atlantic coast, section D, Cape Henry to Key West. September 22, 1916. 19 leaves. 8vo.

Tables for a polyconic projection of maps. (Special publication 5, rev. 4th ed., 1917.) 189 p., 1 text fig. 4to.

## CHAPTER II.

### NEEDS OF THE WASHINGTON OFFICE.

#### CLERICAL FORCE.

The following are needed :

1. Increase in number of clerks.
2. Increase in entrance salary for clerks.

In the report of the Bureau for 1916 emphasis was laid on the fact that the work is greatly handicapped because of the lack of clerical help. It was also explained that though there is a total of 40 clerks in the Bureau, so many of these are assigned to special duties that the persons really doing clerical work are but 25 in number. Conditions in this respect are the same this year as they were last year. The work of many divisions in the office is seriously handicapped because of the lack of clerical help. In some of the divisions, because this clerical work must be done, it has been necessary to assign other employees to it, with the result that higher salaried employees, with technical qualifications, are performing duties that a clerk at much less salary could do better.

The entrance salary for clerks in this Bureau is \$720 per annum. There are six positions at this salary. From the fact that entrance salaries are higher in most other bureaus and departments, a clerk that comes to this Bureau at \$720 per annum only remains long enough to qualify for a better-paying position in another bureau or department. The tabulation below shows how this Bureau has lost the services of low-salaried clerks over a period of 11 years, and how conditions in this respect are bettered as the salary scale increases. This table should be carefully studied.

Fiscal year.	Salary, \$720.			Salary, \$900.			Salary, \$1,000.			Salary, \$1,200.		
	Appropriated for.	Resigned.	Per cent resigned.	Appropriated for.	Resigned.	Per cent resigned.	Appropriated for.	Resigned.	Per cent resigned.	Appropriated for.	Resigned.	Per cent resigned.
1907.....	9	2	22 2/3	3	0	0	3	0	0	8	0	0
1908.....	7	3	42 6/7	6	0	0	3	0	0	8	0	0
1909.....	7	1	14 2/7	6	3	50	3	0	0	8	0	0
1910.....	7	1	14 2/7	6	1	16 2/3	3	0	0	8	0	0
1911.....	7	2	28 4/7	6	2	33 1/3	3	0	0	8	2	25
1912.....	6	6	100	10	0	0	5	0	0	8	0	0
1913.....	6	3	50	10	5	50	5	1	20	8	1	12 1/2
1914.....	6	2	33 1/3	10	0	0	5	0	0	8	0	0
1915.....	6	0	0	10	4	40	5	1	20	8	0	0
1916.....	6	1	16 2/3	10	2	20	5	0	0	8	1	12 1/2
1917.....	6	4	66 2/3	10	3	30	5	1	20	8	0	0
Average.....	.....	.....	35.33+	.....	.....	21.81+	.....	.....	5.45+	.....	.....	4.54+

Fiscal year.	Salary, \$1,400.			Salary, \$1,650.			Salary, \$1,800.		
	Appropriated for.	Resigned.	Per cent resigned.	Appropriated for.	Resigned.	Per cent resigned.	Appropriated for.	Resigned.	Per cent resigned.
1907.....	4	1	25	3	0	0	2	0	0
1908.....	4	0	0	3	0	0	2	0	0
1909.....	4	0	0	3	0	0	2	0	0
1910.....	4	0	0	3	0	0	2	0	0
1911.....	4	1	25	3	0	0	2	0	0
1912.....	4	0	0	3	0	0	2	0	0
1913.....	4	0	0	3	0	0	2	0	0
1914.....	4	0	0	3	1	33 1/3	2	0	0
1915.....	4	0	0	3	0	0	3	0	0
1916.....	4	0	0	3	0	0	3	0	0
1917.....	4	0	0	3	0	0	4	0	0
Average.....	.....	.....	4.54+	.....	.....	3.03+	.....	.....	0

From the foregoing it is evident that the \$1,800 positions are the only ones from which there are no resignations; and that inexperienced clerks are constantly coming into the service. After they have been trained by older clerks and chiefs of divisions, and reach a point where they are fairly able to work alone and without constant guidance they become restless and discouraged by the stagnation in promotions and the results are resignations, to enter more promising fields.

It takes a long time and a great deal of instruction to develop the average incoming clerk to the point where he can transact independently the duties assigned him. A large amount of skilled help is wasted in training the novice. The Bureau is crippled and work is retarded as follows:

1. Loss of time in training the new clerk.
2. Loss of time which a trained clerk would give in the same position.
3. Loss of time where the position is vacant and awaiting an incumbent.

It is further evident that to maintain a reasonable degree of permanence in the trained clerical force obstacles to meritorious advancement should be removed, and encouragement to greater efforts to attain the highest specialization should be given. The figures show that now the chance to advance above \$1,000 per annum is almost nil, and that painstaking effort is not rewarded.

The great amount of overtime by the clerical force does not make up for the lack of numbers, and many details in the line of efficiency, economy, and output of product have to be either abandoned or partly lost in generalization. The field force has been increased but the clerical force has had no additions which are necessary to dispose of the increased output from the field. Overtime by the clerks for the fiscal year ended June 30, 1917, was 619 days, or an average for each one who worked overtime of 19 days.

Furthermore, the cost of living as well as salaries in commercial life have risen to such an extent that the point has been reached when it is hardly possible to induce anyone to accept one of these positions at \$720 per annum.

## PRINTERS.

Salaries for the printers in this Bureau are unusually low, and we must obtain better positions in order to retain competent men in the service. Our lithographic draftsmen receive only from \$1,200 to \$1,400 as compared to the \$1,380 to \$2,100 paid in the United States Geological Survey. Our lithographic transferrers are paid \$1,000 to \$1,200, while in the Geological Survey they receive up to \$1,920.

Plate printers in the Coast Survey are paid \$1,200 per annum. In the Bureau of Engraving and Printing they earn from \$3.07 to \$9.97 per day.

This great disparity in the salaries paid in this Bureau compared with the higher salaries paid in other technical bureaus has made of our service a training school for other departments. They have drawn on us liberally. This is complimentary but discouraging. We have a force of trained enthusiastic men whom we desire to retain in the service, but by reason of the small salaries we are permitted to pay them they are continually dropping out. Figure 38<sup>a</sup> graphically expresses conditions.

## INSTRUMENT MAKERS.

The art of constructing instruments and apparatus used by geodests, astronomers, hydrographers, and others engaged in the work of the Coast Survey is one requiring years of training, and at least an elementary knowledge of mathematics, mechanics, physics, etc.

The work is never specialized, such apparatus never being produced in numbers. Each artisan, therefore, must be fully skilled in all branches of the profession.

The instrument makers of the Coast Survey have been much underpaid, as compared with employees in practically all the crafts short of mere factory hands and laborers in private life. This condition also obtained for many years prior to the present war. Under conditions now prevailing, they may be expected to remain in their positions only as various private reasons prevent them from accepting better salaries elsewhere.

For months it has been impossible to fill a vacancy in our force of instrument makers at \$1,200 per annum.

## NEED FOR HIGHER SALARIES FOR HYDROGRAPHIC AND GEODETIC ENGINEERS.

In my report for 1916 several tables and one diagram shown, contained data comparing the compensation of the hydrographic and geodetic engineers of the Coast and Geodetic Survey, with that of engineers in the Government service elsewhere and in private life.

The appropriation for the fiscal year 1918 made a slight increase in the average compensation of the hydrographic and geodetic engineers, but there is still the necessity for further increase in order that the positions may be made sufficiently attractive to draw young engineers and to hold them after they have been in the Survey a few years and have become familiar with our operations and methods.

For a number of years every man who has passed the aid examination of the Civil Service Commission has been offered a position in

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<sup>a</sup> Not included in this compilation.



the field force of the Coast and Geodetic Survey. Most of them have accepted such positions. It would add to the efficiency of the Survey if, instead of having to offer every one on the civil-service register a position, the appointing officer had a choice of three names from which to select an eligible for the position in question.

There are several reasons why there are not more names on the eligible register for the field positions in the Coast and Geodetic Survey. One is the hardships which must be endured by all who enter the field force. Our engineers must serve anywhere in the United States, Alaska, Hawaii, the Philippines, or our other possessions; it is seldom they have the opportunity to visit their homes more than once a year and then only for a few weeks. When they are in distant parts of the country, it may be several years before they are able to visit their homes. In no case can they expect to have the home life that most men desire. The work done by the engineers is generally in out-of-the-way places, where the surroundings are not such as would appeal to the average engineer.

Promotion is slow in the service and our engineers are inclined to leave the Government service after a few years to seek employment in more remunerative fields. In nearly all cases those who have left the Survey have in a very short time increased their compensation beyond what would have been possible had they remained in the service. Another reason for dissatisfaction among our engineers is that, while promotion is slow, they can not look forward even after many years' service to a compensation which is comparable to that paid by other engineering bureaus of the Government, for the maximum compensation is far below that received by engineers of equal training and experience. The two upper curves of this diagram are copied from an illustration which appeared in a report dated December, 1916, of the American Society of Civil Engineers. All of the engineers of the Coast and Geodetic Survey who have had a few years' experience in its service are eligible for membership in the American Society of Civil Engineers, and therefore it is just to compare the salaries received by our engineers with those received by members of the American Society of Civil Engineers in other branches of the Federal service and in private life.

Still another reason for dissatisfaction among our engineers is the fact that they are not able, during their active service in the Government, on account of the small compensation received, to lay by a competency for their old age. There is yet no provision of law which makes it possible to place our engineers on a waiting list with pay, such as is done in some services, and therefore our engineers as they become old and incapable of performing field work efficiently are reduced in salaries and placed on work which, though light, is still more than men of advanced years should be required to do. If they are unable to do any work, they are dropped from the service without any further pay.

After considering some of the causes for our engineers leaving the service, it is evident that some measures should be provided to add to the stability of the engineering force of the Survey and thereby increase its efficiency. The remedies appear to be increased average compensation and more rapid promotions, also some provision for compensation after the active years of their life have passed. I expect to treat of the matter of more rapid promotion and retirement

pay in a later report. Here, I am placing emphasis on the necessity of providing, at the coming session of Congress, for additional positions which will slightly increase the average compensation of the engineers. There is no doubt whatever of the necessity for having more engineers in order to carry on efficiently the work of the Bureau, which is so vital to the industrial and commercial development of the country. When additional places are provided for, the new positions should be placed in the higher salaries, rather than in the lower ones which are now overloaded.

#### NEED FOR ADDITIONAL DRAFTSMEN.

I laid great emphasis in my last annual report on the statement that the need of additional draftsmen was more pronounced than ever before. As no additional draftsmen have been provided, this statement is still true, but the situation is more serious on account of the accumulation of another year's results to be handled by an entirely inadequate force already in arrears.

It is thought that the failure to obtain an increased force of draftsmen arises from a misconception of the amount and character of chart construction work and the qualifications required of the men who do it.

The impression which prevails to a large extent that when the field results are received in the office they need little more than fine penmanship to make them ready for publication, is not correct. In most cases the plotting and verification of the results of a hydrographic survey requires as much time by an expert in the office as is required in the actual soundings in the field. For wire-drag work the office work consumes more time. Nor is the field sheet when completed in a form suitable for publication for two reasons: The soundings are too numerous and the scale too large for convenient use by the navigator. In fact, a chart contains the information compiled from a number of field sheets, both hydrographic and topographic. The selection of the proper soundings to adequately represent the underwater features of the chart, to emphasize the important features on land, and to generalize the less important, is the work of an expert who has had years of training based on a thorough technical education.

The fine penmanship is the final step in chart construction. It is employed in making a smooth copy of the compiled drawing, if it is decided not to reproduce the latter by an engraved plate. Twenty per cent of the drafting force is assigned to complete and verify the hydrographic sheets of the field parties, whereas double the number are necessary to keep from being in arrears. With the increase of the field force and increased appropriations for field work the disparity between the results to be charted and the draftsmen available to handle it will be greater than ever.

Besides the compilation of new charts for hitherto unsurveyed areas, there is a great mass of material which has to be handled to keep the existing charts up to date. The importance of this new information will be recognized when it is understood that it includes the data concerning the changes caused by all the vast river and harbor improvements in tidal waters, the changes which occur in the great system of lights and buoys on our coasts, and the numerous

reports from other sources of changes in our navigable waters. With respect to the river and harbor improvements, the average number of blue prints received from the United States Engineers in 1915-16, each one the result of a survey, amounted to 475 a year.

Reports from other sources of changes in navigable waters include the surveys from State and municipal engineers.

In 1916 the United States Lighthouse Service maintained in the tidal waters of our coasts over 10,000 lights, beacons, and buoys. Besides keeping track of the constant changes incident to such a large system, our charts are affected by the changes occurring in the Philippine Islands, Canada, Mexico, Central America, and Cuba.

The compilations and drawings of the corrections for keeping the charts up to date require the service of 25 to 30 per cent of the drafting force. Only 10 per cent of the force can be assigned to the preparation of the smooth chart drawings.

What may be termed the "miscellaneous work," which includes constructing field projections, the preparation of original sheets for photographic reproductions, miscellaneous tracings and diagrams, occupies on an average of 20 per cent of the drafting force.

When it is understood that there are between 400 and 500 chart proofs verified a month, in the course of their being printed, it will be recognized that there are few men available for the preparation of new charts, or the reconstruction of our older series of charts which have such objectionable features as two-depth units and skew projections. Also the series of southeastern Alaskan charts are based on very imperfect control.

The question of salaries is closely bound up with that of increases of force. Without adequate entrance salaries and a reasonable prospect of promotion, we can not obtain or retain men who have had the requisite technical training to comprehend the operations in the field and to interpret and combine the results of field operations.

To state the foregoing in briefer form, the drafting section digests and prepares for publication the information which appears on new charts, new editions of charts, or as corrections to new prints to keep them up to date. Its work, therefore, is one of the most important links in the chain of operations required for chart production. A chain is no stronger than its weakest link, and the present force of draftsmen has been inadequate to handle the material directly affecting our charts so as to place it before the navigator with the expedition which its importance demands.

As stated, the present force was inadequate under former conditions. The increase in the field force and the increased appropriations for field work provided for the present fiscal year will render still greater the disparity between the information to be charted and the draftsmen available to handle it.

In order that our draftsmen may fill their positions successfully, besides the necessary manual skill, they must have the technical training comparable to that of a civil engineer. This technical training is necessary for them to comprehend the methods employed by the parties in the field, so that they can interpret the results furnished by the triangulation, the topographic and hydrographic parties, and from this complex mass of material extract the essential data which, when skillfully combined, produce the nautical chart.

It is absolutely necessary to increase the force in all departments alike, otherwise congestion is bound to result in those which are not provided for, thereby tying up all work.

#### IMPROPER QUARTERS IN WHICH THE BUREAU IS HOUSED.

In my last year's report I called attention to the fact that the progress of the work in the Washington office of this Bureau is greatly retarded owing to the unsuitable quarters in which the Bureau is housed. The buildings, one constructed for a residence and the other for a hotel, are wholly unsuited as a place in which to carry on the work of the Bureau, and they are becoming more and more so as records accumulate, and the personnel increases to overflow the already cramped quarters.

Under these conditions, there is constant danger of loss by fire on account of the combustible materials of which these buildings are constructed. These buildings require that a great deal of labor be expended daily to keep them in a sanitary condition, and then the results are not all that are desirable. Because of the lack of room, it is necessary to utilize every available room for the personnel of the Bureau, consequently there is no available space for the installation of facilities and equipment for keeping the buildings in a sanitary condition.

The rooms are small, and in order to secure necessary natural light for engravers and draftsmen, those rooms most favorably located to afford this light must be selected for these employees. As such rooms are widely separated, the drafting and engraving force is scattered throughout the buildings which makes it impossible for the chief draftsman and the chief engraver properly to supervise the work of these employees; and the output is greatly lessened because of the inconvenience of consulting various records and data that are necessary to be used in common by all of the draftsmen or all of the engravers. And even with the force so divided to place each draftsman where the best natural light is available all that is desirable is far from being accomplished. See figure 41,\* which is a fair representation of conditions in these small rooms in which lack of space prohibits the installation of the proper filing facilities for records that must be constantly consulted in addition to poor light. From the lack of room for expansion, two or three drafting tables and a pantograph must be crowded into a room which affords but light sufficient for one drafting table. See figure 42,\* which shows what is desirable in the way of natural light for draftsmen and facilities for filing records which are constantly consulted in the work. This is impossible of attainment in the buildings in which the Bureau is housed. The rooms are too small as they are, and the building too weak to permit structural alterations.

In the course of time, as the Bureau has outgrown its quarters, as temporary expedients, small buildings have been put up adjoining the main buildings, largely for the storage of field equipment, lumber, etc. While these answered the purpose for the time being, the work of the Bureau has increased to such an extent that these small buildings are no longer adequate for the purpose, and they are so crowded with equipment that it is impossible to store things in an orderly manner and make them accessible when needed. See figures 44\* and 45,\* which throw some light on existing conditions.

\* Not included in this compilation.

**Part III.—STATEMENT FOR THE PAST YEAR OF ACCOMPLISHED FIELD AND OFFICE WORK, ACCOMPANIED BY ILLUSTRATIONS, AS REQUIRED BY STATUTE, SHOWING THE PROGRESS MADE, ETC.**

**DIVISION OF HYDROGRAPHY AND TOPOGRAPHY.**

The division of hydrography and topography has supervision of the hydrographic and topographic work on the coasts of the United States and insular possessions; the vessels of the Survey, including their construction, maintenance, repair, equipment, personnel, and office records; the suboffices, including the office of the Director of Coast Surveys at Manila; the completion in the office of the field records of the surveys; the compilation of the coast pilots in the field and office; and the tide and current work of the Survey, including the compilation of the tide tables.

Orders and instructions for the personnel and parties engaged in the above-named work and the necessary correspondence are prepared in the division of hydrography and topography. The division includes five sections, namely, field work, field records, vessels and equipment, coast pilot, and tides and currents.

Following is a general statement of progress of the field and office work. Detailed statements of the work are given in the reports of the chiefs of sections and parties.

**FIELD WORK, ATLANTIC COAST.**

The steamer *Bache* was employed from July 1 to January 9 on a hydrographic and topographic resurvey of the approaches to Hampton Roads, Va., from Cape Henry to Sewalls Point. During a large part of this time the vessel was at Norfolk undergoing extensive repairs, including a new spar deck, while the field work was being done by detached parties living on shore. From December 11 to 14, the *Bache* was one of the fleet of Department of Commerce vessels at the Southern Commercial Congress at Norfolk, Va.

From January 17 to May 26, the *Bache* was employed on offshore hydrography extending out to the 100-fathom curve on the coast of Georgia in the approaches to the Savannah River. This season's work of the vessel completes the offshore hydrography from Winyah Bay, S. C., to Matanzas Inlet, Fla.

From May 26 to June 30, the *Bache* was laid up at Norfolk owing to a shortage of funds, and the officers were employed in the completion of the field records of the offshore work or assigned to other duty.

The steamer *Hydrographer* was employed from July to October on a topographic and hydrographic resurvey of the coast of the Delta of the Mississippi River between Pass au Loutre and South Pass

where it was found that owing to a deposit by the river dry land existed where depths of 10 fathoms were shown on the chart.

From November to May 7, a comprehensive resurvey was in progress of the inland waters from Lake Pontchartrain to Mississippi Sound as far east as Pascagoula by the party on the *Hydrographer* and by detached parties living on shore.

During March and a part of April, the vessel was at Mobile, Ala., undergoing repairs, which included the installation of an electric-light plant.

From May 7 to June 22, the vessel continued work in the approaches to the Mississippi River. The detached parties continued work in Mississippi Sound until May 23, when they were disbanded for lack of funds.

The steamer *Isis* was at Norfolk undergoing alterations and repairs from July to December 20, when she came to Washington to have the radio apparatus installed. While repairing at Norfolk, a number of the officers were transferred to the *Bache* to assist in the hydrographic and topographic survey of the approaches to Hampton Roads.

From December 11 to 14, the *Isis* was one of the fleet of Department of Commerce vessels at the Southern Commercial Congress at Norfolk, Va.

From January 6 to April 30, the vessel was employed on offshore hydrography extending out to the 100-fathom curve on the coast of Florida for a distance of 40 miles south from a point 5 miles south of the St. Johns River.

The vessel was laid up at Norfolk from May 2 to June 30, because of a shortage of funds, during which time some minor repairs were made and the office work of the past season's records was completed.

The schooner *Matchless* completed the resurvey of the easterly side of Pamlico Sound from Ocracoke Inlet to the vicinity of Cape Hatteras, and Little River, Perquimans River, Yeopim River, Bull Bay, and Scuppernong River, tributaries to Albemarle Sound, N. C.

Repairs were made at Elizabeth City, N. C., during a part of the winter.

From May 4 to June 8, the vessel was laid up at Elizabeth City due to a shortage of funds, during which time minor repairs were made to the vessel.

Wire-drag party No. 1 completed the survey of the northerly approach to Boston Harbor, between Nahant and Cape Ann. Current observations and chart revision work were done in conjunction with the wire-drag work.

A striking feature of this wire-drag work is the large area covered in spite of the unusually numerous changes from the charted depths that were found. The party was able to accomplish this result by taking advantage of the best weather to drag the exposed, deep-water areas while the inshore work was done during less favorable weather. The deep-water work was expedited by the use of a drag 15,000 feet long, towed by two launches, and several records were made with this exceptionally long drag.

An area of about 200 square miles was examined with the drag and in this area nearly 300 changes were discovered. The importance of a large number of these shoals, because of their danger to navigation,

can not be fully appreciated without an examination of the chart, especially in the entrance to Salem Harbor and in the vicinity of Thatcher Island.

In a letter reporting that the field work of his party had been completed, the chief of this party stated:

In spite of the many years spent by me on wire-drag work, I consider the work done since October 1 in Salem Harbor and approaches to be the most striking example of the need for and the possibilities of wire-drag work on a coast that has been navigated for 300 years.

The work was resumed during May and June, 1917, in the approaches to Portsmouth Harbor, N. H.

Wire-drag party No. 2 continued the survey of Cape Cod Bay between Plymouth and Cape Cod Canal. It was found that the bowlder formation which resulted in the discovery of numerous uncharted rocks between Plymouth and Cape Ann does not extend south of Plymouth Harbor, and the work progressed rapidly, being completed on August 16.

This party then took up the survey of Block Island Sound in the vicinity of Montauk Point and including Gardiners Bay. During the season a subparty made a hydrographic and topographic resurvey of Plymouth Harbor, Mass., and the hydrographic and topographic survey of Fort Pond Bay was revised. The work was resumed during May and June, 1917, in Block Island Sound in the approaches to Narragansett and Buzzards Bays.

Wire-drag party No. 3 was organized at Key West in the latter part of April, 1917, and has been employed during May and June on a comprehensive survey of the Florida Reefs.

A large number of uncharted rocks were found by the wire-drag parties in the regions examined. These were reported promptly, and wide publicity was given them through the Notice to Mariners and the press.

A shore party was engaged from August 18 to December 5, 1916, revising the topography and triangulation of Long Island from Matinick Point to Eatons Neck including Oyster and Huntington Bays.

A party using chartered launches completed a comprehensive tide and current survey of the westerly part of Long Island Sound from Execution Rocks to New Haven, during the period from August 5 to November 10, 1916. Currents were observed for 51 hours each at important stations in the sound and the principal tributaries.

Automatic tide gauges were maintained at selected stations during the work, staff gauges were operated for short periods at numerous other stations, and approved bench marks were established for all stations and connected up with all previous work of this character which embraced a number of years' observations. On May 24, 1917, this work was resumed in Long Island Sound.

A revision party using a chartered launch was employed in supplementing the hydrography along the shores of Long Island Sound from July 26 to November 23, 1916. The party completed the inshore hydrography from Norwalk Island to Black Rock Harbor on the north side of the sound and from Eatons Neck to Oak Neck Point on the south side of the sound, including Huntington and Oyster Bays and tributaries. Numerous uncharted rocks were found

and the safety of navigation was greatly promoted for the great fleet of small craft navigating these waters.

Revision surveys for the location of prominent natural objects and building and locating tall hydrographic signals were made on the coast of Georgia and Florida from October 23, 1916, to March 22, 1917. This work was done by shore parties for the use of the *Isis* and *Bache* in the offshore hydrographic work.

The field revision of the Inside Route Pilot from New York to Key West, which had been made as far as St. Augustine on July 1, 1916, was completed on July 13, 1916.

At the request of the Navy Department, an officer of the Survey revised the speed trial course at Provincetown, Mass., by shifting the ranges, erecting new beacons and verifying the length. This work was done between July 26 and September 20, 1916.

Suboffices of the Survey, each in charge of a field officer of this Bureau, were maintained at New York and Galveston. A stock of charts and other publications of the Survey was kept on hand for consultation by the public and for sale. During the year, a clerk has been assigned to the suboffice at New York, which enabled the field officer in charge to execute some field work within his district. In addition to collecting and giving information, the officer at Galveston has cooperated with the Steamboat-Inspection Service by examining many seamen for certification in compliance with the seamen's act.

#### FIELD WORK, PACIFIC COAST.

A shore party using a chartered launch made a hydrographic and topographic resurvey of San Diego Bay from November, 1916, to February, 1917. The previous surveys of parts of this area were made 60 years ago, and local interests in requesting the survey stated that because of enormous floods during 1916 the depths in parts of the bay had entirely changed.

Wire-drag party No. 4 surveyed San Francisco Bay and the Golden Gate from November 16, 1916, to March 17, 1917. In addition, a topographic revision of the bay was begun. A pinnacle rock with a least depth of 29 feet at mean low water was found about one-third of a mile westward from the former position of Shag Rock, where a least depth of 46 feet was shown on the chart.

At the request of local interests, an officer of the Survey made a hydrographic resurvey of the west side of San Francisco Bay in the vicinity of Point San Bruno from May 21 to June 17, 1917.

A shore party using a chartered launch was employed from February 5 to April 16 on a comprehensive tide and current survey of Puget Sound southward of Seattle.

Currents were observed from the launch anchored at important stations in the sound and by the tide observers from wharves.

Automatic tide gauges were maintained at selected stations during the work, staff gauges were operated for observing during periods from 60 to 96 hours at 18 subsidiary stations, and approved bench marks were established for all stations and connected up with all previous work of this character, which embraced a number of years' observations.



At the request of the Navy Department, currents were observed in Richs Passage by the parties from the steamer *Explorer* from March 16 to April 13, 1917.

Wire-drag party No. 3 was employed from November 18 to March 8 on surveys in the vicinity of the Puget Sound Naval Station. A wire-drag survey was made of the principal channels, a lead-line development was made to complete the hydrography of the principal tributaries, and the triangulation and topography in the vicinity of Port Orchard were revised to bring them up to date.

A shore party was employed from April to June, 1917, on a revision of the triangulation, topography, and hydrography in the vicinity of Seattle. To the close of the fiscal year, the work in the vicinity of the new waterway joining Shilshole Bay with Lake Washington was completed. At the request of the Navy Department, the submarine trial course at Port Townsend was verified and re-marked.

A field revision of the Pacific Coast Pilot, California, Oregon, and Washington, was made from June to October, 1916. In the course of this revision, the entire coast was covered and a special study was made of the unusual conditions affecting navigation on that coast.

#### FIELD WORK, ALASKA.

The steamer *Patterson*, during the summer of 1916, was employed in southeast Alaska on the survey of the passages leading southward from Sumner Strait. The charts of this locality were based on a reconnaissance made by the same vessel in 1886. The *Patterson*, in cooperation with the wire-drag parties, was intended to furnish continuous and complete surveys for all passages between Clarence Strait and Eastern Passage. The vessel was on the working ground until October 24, 1916.

The triangulation included a secondary scheme through Snow Passage, connecting previous work in Clarence Strait with that in Sumner Strait; tertiary triangulation through Kashevarof Passage from Coffman Island to Tide Island; location by tertiary triangulation of many intersection points for control of the topography in Clarence Strait between Point Harrington and Ernest Sound and which was carried into Rocky Bay and McHenry Inlet; and tertiary triangulation in Ernest Sound and Zimovia Strait from Clarence Strait to Blake Channel and Chichagof Pass.

The topography was completed for Kashevarof Passage, Kashevarof Islands, and Whale Passage from Lake Bay to Point Colpoys. The west shore of Etolin Island from Point Harrington to Onslow Point and Stone Islands has been completed, except Mosman Inlet and the lower end of Burnett Inlet. Some topography was also done in Zimovia Strait and from Wrangell to Point Highfield.

The hydrography includes Kashevarof Passage, Whale Passage, the west shore of Etolin Island from Point Harrington to Mosman Point, McHenry Inlet, and some work in Zimovia Strait and around Point Highfield.

The *Patterson* arrived at Seattle on October 31, was laid up and her crew reduced. Repairs were made during the winter. On April 25 the vessel left Seattle for the field of work in southeastern Alaska, which embraces the entrance to Cross Sound and the unsurveyed

outer coast of Chichagof Island. On May 24 the rudder of the *Patterson* was disabled by striking an uncharted rock in the entrance to Lisianski Strait. Repairs were effected at Juneau and the vessel resumed work about the middle of June.

The steamer *Explorer*, during the summer of 1916, was employed in southeast Alaska on a comprehensive survey of the unsurveyed outer coast from Cape Muzon to Meares Passage. The bottom in this locality was found to be exceedingly broken, and the dangers rose abruptly from depths of about 50 fathoms.

The weather was very unfavorable for the work of the ship, there being a great deal of fog and it being necessary to observe on the mountain peaks for signals. Three detached parties were generally kept in the field, and these were located so as to take advantage of parts of days when work could be done.

The topography accomplished includes the completion of the entire coast from Cape Muzon to a junction with previous work in Meares Passage. By means of triangulation stations on Wolf Rock, Lowrie Island, and Forrester Island, points were determined at frequent intervals along the coast to control the topography, and mountain peaks were located in the same way for the control of the offshore hydrography. The triangulation was also connected with that of the inside passage through Meares Passage.

The hydrography accomplished includes the indentations of the coast and the offshore work westward to a north and south line extending through Forrester Island and Wolf Rock from the parallel 4 miles southward of Cape Muzon to a junction with the work previously done at the entrance of Meares Passage. The part of the work northward of Cape Augustine, however, will require additional development.

The vessel was laid up at Seattle with a reduced crew and repairs were made at Seattle during the winter.

At the request of the Navy Department, currents were observed and some hydrographic work was done in Richs Passage in the approach to Puget Sound Naval Station.

After outfitting at Seattle, the vessel sailed for southeast Alaska on May 1, and during the balance of the fiscal year resumed the surveys of the outer coast of southeast Alaska northward of Cape Muzon.

The steamer *Taku* surveyed Orca Inlet and the delta approaches from southeastward for the use of fishing vessels and small craft employed in that vicinity. The triangulation was carried along the flats for a distance of about 15 miles eastward from Point Whitshed, and included the location of the radio towers on the point and the new radio station about 10 miles eastward of Cordova.

The hydrography included Orca Inlet from Cordova to Hawkins Island Cut-Off, Roswell Bay, and the flats inside of the outer islands for a distance of about 15 miles eastward from Point Whitshed. The inlets at Point Bentinck and Egg Island were developed and the 10-fathom curve on the outside of the flats was located for most of this stretch.

The topography included the shore from Cordova southward to and around Point Whitshed, Boswell Bay, Point Bentinck, and the

outlying sandy islands for a distance of about 15 miles eastward of the point. A subparty surveyed the Orca Military Reservation, which included the tributaries and north shore of Orca Bay from its head down to and including Sheep Bay, and the greater part of Hawkins Island northward of Canoe Pass. For this survey contours of 50-foot intervals were determined with more than usual care, and numerous stations were established and marked for future use.

The *Taku* was laid up at Cordova, Alaska, during the winter and the party returned to Seattle.

The party returned to the vessel and on May 2, 1917, repairs were begun, preparatory to resuming work in Prince William Sound. After the completion of repairs, the party took up triangulation, topography, and hydrography in the northwest end of Prince William Sound.

The steamer *Yukon* has been laid up at King Cove, Alaska Peninsula, during the entire year. In June, 1917, a party was organized to repair the vessel for field work in the vicinity of King Cove.

Two wire-drag parties were employed on the Pacific coast during the fiscal year, the working season in Alaska embracing the periods from July 1 to about the middle of October, 1916, and from about the middle of April to June 30, 1917. Both parties had a very satisfactory season, and the importance of the results accomplished can hardly be overestimated. The extent to which navigation in this region has been safeguarded by the discovery of uncharted shoals can hardly be realized without a glance at the charts affected.

In addition to the wire-drag work, the parties have carried out an extensive scheme of triangulation and topography and have obtained valuable current and tidal observations. Another feature of the work has been the close and successful cooperation between the wire-drag parties and the party of the steamer *Patterson*.

Wire-drag party No. 3 began work in Clarence Strait and carried the work systematically up this important waterway until all the open water between the limit of the previous season's work and Zarembo Island had been dragged, after which work was begun in the exposed parts of Ernest Sound. This work was carried to Eaton Point on Cleveland Peninsula during the season, and the survey of Kashevarof Passage was completed. Chichagof Pass and a part of Stikine Strait were also dragged.

Wire-drag party No. 4 began work near the eastern end of Sumner Strait, connecting with the work of the 1915 season. This work was later joined by the work of party No. 3 at the north end of Clarence Strait. Considerable work was also done at the southern end of Sumner Strait during the first part of the season. From the eastern end of the strait the work was carried along the channel between Mitkof Island and Zarembo Island to the entrance of Eastern Passage. A junction was effected with the work of party No. 3 in Stikine Strait and at the eastern end of Chichagof Pass. Eastern Passage and Blake Channel were dragged and, during the last month of the season, the work was extended through Bradford Canal and the main channel of Ernest Sound to Point Peters on the south end of Deer Island.

## FIELD WORK, PHILIPPINE ISLANDS.

The work of the Survey in the Philippine Islands is executed under the direction of the Director of Coast Surveys, an officer of the Coast and Geodetic Survey, who, acting under authority of the Superintendent, makes plans for the work, issues detailed instructions to the field parties, and also has charge of the suboffice at Manila. The expenses of the work are met partly from the appropriation for the Coast and Geodetic Survey and partly from funds provided by the Philippine Government, which also furnishes four vessels for surveying purposes. One steamer, the *Pathfinder*, is furnished by the Coast and Geodetic Survey.

The five vessels of the Survey have been kept at work in the field as continuously as possible, being absent from the field only for the purpose of renewing coal and other supplies and having the necessary repairs made. In the item of party expenses, the continued advance in the price of coal has further increased the cost of the work, as mentioned in the last report.

The steamer *Pathfinder* closed operations in the vicinity of Balabac on July 10, 1916. From August 4 to October 17, combined operations were carried on in the vicinity of Polillo Island. Repairs were made at Olongapo from October 22 to November 29. On December 7, the vessel proceeded to Balabac and continued general surveys until January 10, when she returned to Manila. From January 17 until April 30, she was undergoing extensive repairs at Olongapo Naval Station. The balance of the year the *Pathfinder* was engaged in general surveys at Polillo Island to facilitate the mining of coal recently discovered in that locality.

The steamer *Fathomer* was at Manila undergoing repairs until September 11, 1916. From September 13 until January 29, she was surveying the Busuanga Islands, the vessel engaged in hydrography and a detached party executing the topography. From February 1 to March 17, the vessel was at Manila for general overhauling and repairs, and then returned to Busuanga Islands on March 21, when the survey of those islands was resumed and was in progress until about the close of the fiscal year; the principal work this season has been launch and ship hydrography.

The steamer *Romblon* was employed from July until December among the Cuyo Islands, except from August 3 to September 18, when the vessel was at Manila for repairs. This work, which was principally hydrography, was closed on December 19; after a brief visit to Manila the vessel left for the south end of Palawan Island where combined operations have since been carried on.

The steamer *Marinduque* continued work on the east coast of Palawan Island until December 15. This work was greatly handicapped by the great distance, 250 miles, from her coaling station. Leaving Palawan December 15, while en route to Manila, the in-shore hydrography and topography of Cambari Island and some topography in Dumaran Channel were finished and several uncharted reefs and shoals were found and reported. The vessel remained at Manila undergoing repairs until February 10. Combined operations were then taken up in Green Island Bay and vicinity, and

on the east coast of Palawan. They were in progress to the close of the fiscal year.

The steamer *Research* was engaged on a hydrographic survey of the approaches to Iloilo until October 11, after which she was employed in making a general survey of Manila Bay. The latter work is still in progress.

#### SECTION OF FIELD WORK.

This section, as a part of the division of hydrography and topography, has had supervision over the field work with special reference to the methods used and the completeness and extent of the work.

The general locality of work contemplated having been designated by the chief of division, investigations with respect to differences of existing surveys, the character of the locality, the nature of the bottom, and the required closeness of the work to be done are taken up by this section, and data prepared for the final instructions to the chief of party.

This section, which was created in 1915, has had opportunity to realize the benefits derived from supplying the chiefs of parties with carefully prepared data and memoranda for the work to be done. By a careful study of the conditions surrounding the area to be surveyed, a review of former survey records and of data on file in the archives, this section has had opportunity to place before each chief of party data and results which assist him to efficiently direct his operations. The resulting benefit to the work has been considerable. Parties in following the detailed instructions have obtained results that are satisfactory in every detail.

Diagrams showing the progress of the work of each party have been kept and the record of each month's output has been carefully drawn. This enables the section to ascertain at a glance the advisability of continuing the work in any one direction beyond the prescribed limits and to correlate it with surrounding work of similar character.

Investigations and comparisons of surveys with respect to differences and changes occurring from time to time have been carried on with a view to ascertaining the necessity of resurveys.

Inspection of field sheets has been carried on when the opportunity presented. Many miscellaneous duties have of necessity been performed by the chief of the section and the time for critically inspecting all of the field sheets has been limited.

#### SECTION OF FIELD RECORDS.

The principal duty assigned to this section is the inspection of the data submitted by the field parties and their completion for publication and the files. This inspection of the field results has been extended to cover preliminary studies of miscellaneous reports and records for use in formulating detailed plans for the conduct of the work in the field, and takes into consideration both the means available and the general program of operations.

In connection with the review and analysis of the results submitted by the field parties, there are noted the imperfections of present

means and methods of conducting our operations, and where possible these shortcomings are corrected in subsequent work. There are also developed and reported methods of treatment and suggestions for use in publishing the collected field data.

In addition to the final review of the field results, examinations of the work as it progresses are made, and preliminary instructions modified to meet the changing requirements of the work as it is developed.

This section has handled many miscellaneous requisitions and assignments; in fact, such items have constituted the major portion of its work.

Department and Bureau publicity, through publications, lectures, and exhibits, received considerable attention and entailed much work in the preparation of text and illustrations.

Inquiries in regard to various technical subjects from public and private institutions and individuals were answered as fully as possible and in such manner always as to encourage appeals to this Bureau for information in any way bearing upon its work.

#### SECTION OF VESSELS AND EQUIPMENT.

The section of vessels and equipment is charged with the construction, maintenance, and improvement of the vessels and their equipment. It also has supervision over the expenditures for the operations of the vessels and other hydrographic parties and general supervision over the ships' officers and crews.

One new vessel, the *Surveyor*, was completed during the past year, all plans and specifications for which were reviewed and passed upon in this office. The boats, launches, and equipment for the vessel were selected and constructed or purchased under the immediate supervision of this section.

Extensive alterations and repairs were made to the steamer *Isis* during this year. This vessel, constructed as a yacht, was purchased in 1915 and put to work as a surveying vessel with very few changes. Because of lack of funds at the time of the purchase and for other reasons the contemplated changes in the arrangement of the vessel were deferred until last summer.

At least one thorough inspection of each vessel of the Service, except the vessels in the Philippine Islands and the two small vessels in Alaska, was made by the chief of section during the past fiscal year. The inspection of the Alaska and Philippine vessels was delegated to officers of the Bureau in those localities and the reports of inspection submitted to this office for consideration. There were frequent inspections made of the Atlantic coast vessels and of the vessel and launches under construction. When repairs were considered necessary, they were made under the direction of this section.

An important part of the work of the section has been the standardization of field equipment and considerable progress has been made along that line, particularly in the matter of launches and boats. The Bureau has worked out and decided upon the types of boats and vessels best suited to its needs for each kind of hydrographic work and is prepared to call for bids immediately upon the appropriation of the necessary funds.

Careful analysis and study have been made of all estimates for field expenses of hydrographic parties with the result that all unneces-

sary expenditures have been eliminated. Contracts for repairs, purchases, or hire of launches have received careful examination, and methods and procedure in such matters have been standardized.

#### COAST PILOT SECTION.

During the year this section carried on field work on both the Atlantic and Pacific coasts and in Alaska and, as a result of the field work, two coast pilots, "Alaska, Part I, from Dixon Entrance to Yakutat," and "Pacific Coast, California, Oregon, and Washington," and one inside route pilot, "New York to Key West," were compiled. The last-named volume was distributed in December, 1916; the other two are at present in the hands of the printer.

During the year such supplements or correction sheets were issued as were necessary to keep the information in all volumes up to date.

A large amount of routine correspondence was handled by this section, consisting principally of answers to inquiries on a wide variety of nautical matters. The section also made special reports to the Bureau of Lighthouses, at their request, concerning the most advantageous location of a number of very important aids to navigation.

The record of the issue of coast pilots in recent years is interesting as indicating the usefulness of these publications. As these volumes are sold at a price sufficient to defray the cost of printing (50 cents for coast pilots and 20 cents for inside route pilots), it is obvious that the number sold furnishes an accurate measure of the public demand. The following is the record of sales for the fiscal years from 1911 to date:

	Volumes.
1911 -----	2, 720
1912 -----	3, 792
1913 -----	5, 545
1914 -----	5, 228
1915 -----	6, 292
1916 -----	7, 422
1917 -----	9, 739

#### SECTION OF TIDES AND CURRENTS.

Tidal observations were made throughout the year at seven permanent tidal stations on the Atlantic coast, three in the Gulf of Mexico, three on the Pacific coast, and one in Alaska, in addition to tidal observations made in connection with all hydrographic surveys in the United States, Alaska, and the Philippines.

During the year all permanent tidal stations have been inspected at least once, the inspection in all cases including the connection of the tide staff of the station with the permanent bench marks.

In the summer of 1916 work of a new class was commenced, the making of a complete tidal and current survey of the coasts of the United States. For three months in the summer and fall of 1916 and for one month in the summer of 1917, this work was carried on in Long Island Sound, N. Y., and similar work was done in Puget Sound, Wash., for three months in the early part of 1917.

The purpose of the tidal survey is to obtain tidal information at important points along the coast and the establishment of a system

of permanent tidal bench marks at all principal points along the coast, which will serve the public in all cases where a knowledge of tidal planes is required, such as for engineering operations, city and land surveys, surveys of oyster areas, and many other purposes; which will furnish hydrographic parties with standard datums; and which will afford starting and checking points for lines of precise levels.

The purpose of the current survey is the obtaining of definite information concerning currents in channels, entrances to bays, rivers, passages, and at points along the coast, for the benefit of navigators.

The tidal survey is carried on by means of two automatic tide gauges and several subsidiary staffs; current measurements are made by means of Price current meters, the velocity being obtained at various depths at each station.

Tidal indicators, exhibiting automatically the stage and height of the tide, were maintained throughout the year at Fort Hamilton and New York, N. Y., and at Reedy Island, Delaware River.

A special current survey was made of Richs Passage and the approaches to the Bremerton Navy Yard, Puget Sound, Wash.

For the benefit of navigation, two tide staffs were erected in Wrangell Strait, Alaska, one at the northern and one at the southern end of the strait. These staffs were set with their zeros at the plane of reference used on the charts, so that navigators could see directly from the staff what correction should be applied to the soundings on the chart to give the depth of water at that time.

A special effort has been made to have newspapers in the principal seacoast cities of the country publish official tidal and related data, giving credit for the same to the Survey, and a number of newspapers in Washington, Baltimore, New York, San Francisco, Seattle, and some other cities have responded.

The Tide Tables for 1917 were received from the printer in October, 1916. In these tables considerable additional information along tidal and current lines has been added, the tables have been greatly enlarged and simplified, and all information has been put in a form specially adapted for the use of mariners and others using the tables. The increase in the value of these tables is shown by the increased sale, especially of the Atlantic and Pacific Coast Tide Tables, as shown in the following table for the fiscal year:

Tide Tables for—	General Tide Tables.	Atlantic Coast Tide Tables.	Pacific Coast Tide Tables.
1909 .....	1,008	1,405	9,430
1910 .....	999	1,354	9,376
1911 .....	1,042	1,575	9,702
1912 .....	1,001	1,447	10,405
1913 .....	1,008	1,507	9,655
1914 .....	1,126	1,684	10,882
1915 .....	1,665	1,994	10,481
1916 .....	1,166	2,367	10,084
1917 .....	1,548	2,526	12,704



The Tide Tables for 1918 were prepared and sent to the printer; considerable additional information along tidal and current lines has been added, and several changes have been made with the view of facilitating the use of the tables and adapting them to the needs of mariners and others making use of the tables.

Considerable new current information was prepared for coast pilots of Alaska, south of Yakutat Bay; Pacific coast, Washington, Oregon and California; and for the Gulf of Mexico.

A new form for evaluating the wind effect upon observed currents has been made and is now in use. This will make it possible to obtain accurate figures for the effect of the wind upon the currents along the coasts which is of the greatest value to navigation.

#### ASSISTANCE RENDERED IN SAVING LIFE OR PROPERTY.

On August 17, 1916, the officers and crew of the steamer *Patterson*, C. G. Quillian commanding, were called upon to assist in reviving five men of the crew of the cannery tender *Mary Maloney*, who had been asphyxiated, presumably by gasoline fumes. Earlier in the season Capt. Quillian had the officers and men of his command drilled by Dr. Marchand in methods of inducing respiration and the resuscitation of apparently drowned persons and, due to this training, all of the asphyxiated persons were treated at once. Two of the men revived under the treatment, but the others were either dead on arrival of the *Patterson* or too far gone for successful treatment. It is believed that more, if not all of the men, would have responded to treatment if taken in hand earlier. This incident indicates the importance of a working knowledge of the methods of resuscitation by all members of the service.

On October 21, 1916, the steamer *Marinduque*, A. M. Sobieralski commanding, took the small schooner *Florence* in tow at Araceli, Palawan. She was in distress with sails blown away and part of the rigging gone and food and water low. Although the *Marinduque* was short of coal she towed the *Florence* to Coron and took the captain to Manila.

The rescue from drowning by a boat from the steamer *Bache*, Paul C. Whitney commanding, of a seaman who had fallen overboard from the British steamship *Kelvinbrae* is commended by the Department in a letter dated March 30, 1917. The rescue was accomplished at a time when it was very dark and in the face of a high wind and strong flood tide.

On April 28 the steamer *Isis*, G. T. Rude commanding, bound up the St. Johns River, Fla., assisted in putting out a fire on the steam schooner *Rosalie Mahoney*, beached on the east side of the river. The *Isis* went alongside the *Rosalie Mahoney* and for three hours used her fire hose and crew to assist in getting the fire under control.

On February 18, 1917, a fire occurred on the water front in South Jacksonville at a lumberyard and shipbuilding plant. Before the fire was under control a launch from the *Isis* was sent over and towed the yacht *Soncy* to a safe berth.

## DIVISION OF GEODESY.

## FIELD WORK.

A primary triangulation party operated on the Utah-Oregon arc during the summer and fall of 1916. The arc was completed early in September. The work on this arc was begun during the previous fiscal year and the object was to furnish control for topographic and other surveys in a region that previously had no control whatever. The results will be immediately useful to the topographic engineers of the United States Geological Survey and to the officials of the Forest Service.

Upon the completion of the Utah-Oregon arc the primary triangulation party which had been operating on it was transferred to Utah and work was begun on the arc which will extend from the trans-continental triangulation in that State to the Texas-California arc of primary triangulation in the vicinity of Needles, Cal. Shortly after the observing party and the light keepers took their stations on mountain peaks, which were used as triangulation stations, heavy weather set in. The snow was so deep on some of the peaks that some of the equipment of the parties had to be abandoned as it was impracticable to pack it out. The triangulation therefore had to be abandoned for the season. It was the intention of the Survey to begin observations on that arc early in the summer of 1917, but the war made it necessary to alter the plan. The observing on this arc will be done as soon after the end of the war as is practicable.

Upon abandoning the primary triangulation in Utah, the chief of that party organized a smaller party and made a reconnoissance from the vicinity of Las Vegas, Nev., to a point on the oblique boundary between Nevada and California to the westward of that place. This reconnoissance was for the purpose of extending a spur to the State boundary from the Utah-California arc of primary triangulation. This connection will strengthen the triangulation which was done some years ago along the boundary in question, and will help to coordinate the former work.

Primary triangulation was started in the vicinity of Little Rock, Ark., and carried westward into Oklahoma. This work is a continuation of the arc which previously had been extended from Huntsville, Ala., westward through Memphis to Little Rock. A portion of the arc between Memphis and Little Rock was primary traverse instead of primary triangulation. The change to the traverse was found desirable on account of the country passed over and the high trees. Primary triangulation would have required an excessive amount of signal building which would have been very expensive.

The arc in question will be continued westward to a connection with the ninety-eighth meridian triangulation in the vicinity of El Reno. The work was abandoned in January when the winter weather made transportation very difficult. The progress was retarded by this condition and it was thought best to postpone further work on the arc until the late spring of 1917. As in the case of the Utah-California arc, it was found impracticable to continue on the Little Rock-Oklahoma work on account of the necessity for changing plans as a result of the war.

A building party was organized to erect signals ahead of the observing party on this arc. It operated at first under the general direction of the chief of the reconnoissance party which was operating to the westward of El Reno, Okla. Later it was transferred to the general direction of the party in charge of the primary triangulation to the westward of Little Rock.

A party operated during the early part of the fiscal year between Oklahoma and California, making a reconnoissance for primary triangulation which will follow the general direction of the Atchison, Topeka & Santa Fe Railway from the vicinity of El Reno, Okla., to Needles, Cal. This work was completed and is available for the use of the primary triangulation party which, it is planned, will make the observations as soon as practicable.

During the last month of the fiscal year a party was organized in the vicinity of Harlingen, Tex., which began making a reconnoissance for primary triangulation which will extend from the vicinity of that place northwestward to the Texas-California arc in the vicinity of Van Horn, Tex.

Preliminary plans were made to have subparties work under this reconnoissance party and erect signals over the stations selected. The observing on this arc will begin early in the fiscal year 1918. The work on this arc was called for by the office of the Chief of Engineers, United States Army, for the control of surveys and maps, for military purposes.

On all of the primary triangulation and reconnoissance for primary triangulation done during the fiscal year 1917, motor trucks were used as the means for transportation. On account of the fact that the money spent for labor is one of the heavy items of expense in this class of work, the use of the trucks is very economical in enabling the observers to utilize much of the time for observing which formerly was employed in moving by teams from station to station.

It will probably be only occasionally that horses and wagons can be used in the future on primary triangulation and reconnoissance to better advantage than trucks. With the increase of good roads throughout the country the trucks will become more and more economical on geodetic work.

During the fiscal year primary triangulation was done in southeast Alaska, on an arc which will eventually extend from the vicinity of Tacoma, Wash., to the intersection of the Yukon River and the one hundred and forty-first meridian. The Coast and Geodetic Survey will do that portion of the arc which extends from Tacoma to Point Roberts, Wash., and from Dixon Entrance to White Pass, at the head of Lynn Canal, in southeast Alaska. It is expected that the Geodetic Survey of Canada will make the triangulation along the remaining parts of the arc. These portions of the arc are from Point Roberts to Dixon Entrance and from White Pass, down the Yukon River, to the one hundred and forty-first meridian. The completion of this arc will be a matter of considerable importance to northwest Canada and to Alaska, for it will make it possible to extend the North American Datum into those regions. This datum, as is well known, is now used almost exclusively in the United States wherever the connected scheme of triangulation extends. When a survey and

map have been placed on that datum they will never have to be changed, so far as geographic positions are concerned.

The primary triangulation in southeast Alaska is used at the present time to control wire-drag surveys that are in progress. The primary triangulation done in the summer and fall of 1916 was done by a subparty of one of the wire-drag parties. During the spring and summer of 1917 the primary triangulation was done by two separate parties, organized especially for this work.

In the spring of 1917 the Office of the Chief of Engineers, United States Army, requested the Survey to run certain lines of primary traverse in Georgia and Florida for the control of surveys made by the United States Geological Survey for the purpose of furnishing military maps for the War Department.

Two primary traverse parties were organized early in April and they continued in operation throughout the remainder of the fiscal year. One of the lines of traverse extends from Jacksonville, Fla., to Columbus, Ga., by way of Waycross, Ga. The other line extends from Brunswick to Columbus, Ga., by way of Macon. These two traverses will be connected at Columbus. They start from the coast triangulation in the vicinity of Jacksonville and Brunswick. During the progress of the primary traverse, azimuths were observed on Polaris at such intervals as were necessary for the control of the directions of the lines of the traverse. It is planned to have the astronomic longitude of each of the azimuth stations determined in order that the observations for astronomic azimuth may be corrected for the local deflection of the vertical.

The observations on the traverse for the determination of the lengths of the various sections were made with invar base tapes, with the tapes stretched along the top of the rail of the railroad. In order that the measurements might be reduced to the horizontal, precise leveling was run along the line of the traverse and the resulting elevations were furnished to the traverse parties, in order that they might compute the grade corrections. The leveling was done by separate parties.

At the end of the fiscal year 1916 a precise leveling party was operating in Florida. This party continued work until the spring of 1917. The work accomplished during this fiscal year consisted of a line of levels extending from the vicinity of River Junction, Fla., to Mobile, Ala., by way of Atlanta and Birmingham.

When the party mentioned above reached Mobile, it was ordered to discontinue work in Alabama and to proceed to Jacksonville, Fla., and run a line of levels from that place toward Columbus, Ga., by way of Waycross and Albany, Ga. The route followed by this line of levels is the same as that followed by the line of primary traverse mentioned above. The work had not been extended to Columbus by the end of the fiscal year. This leveling party made such extra observations along the railroads as were necessary to supplement the regular observations of a precise leveling party, in order that sufficient data might be furnished the primary traverse party to enable the latter to reduce the traverse measurements for the inclination of the rails on which the measuring tape was supported.

A second precise leveling party operated in Georgia during the last three months of the fiscal year on the line which extends from Brunswick toward Columbus, by way of Macon. This line of levels will be connected with the one mentioned above which extends from Jacksonville to Columbus. The leveling from Brunswick follows the route taken by the primary traverse party in running its line between those two places. As in the case of the other precise leveling party working in Georgia, data were furnished by it to the primary traverse party to be used in making grade corrections to the measurements of distances.

Early in the fiscal year a line of precise levels was run between Little Rock, Ark., and a point on the Mississippi River, just to the westward of Memphis, Tenn. The object of this line of precise leveling was to furnish data with which to compute the grade corrections for the primary traverse which had previously been run over the same route. The traverse work had been completed just before the end of the fiscal year 1916.

The precise leveling party which had been operating in Indiana during the fiscal year 1916 continued operations in that State and also worked in Illinois and Michigan during the first half of the fiscal year 1917. During the fiscal year 1917 a line of levels was completed which extends between Chicago and a point near Detroit, by way of Jackson, Mich. This line had been begun during the previous fiscal year. The line of levels which extends from Jackson to Mackinaw City, Mich., was also completed during the fiscal year 1917.

All of this work in Indiana, Illinois, and Michigan was done by a single party. It is worthy of note that, during the season, a new record was made for rapidity for carrying on this class of work. During the month of September a progress along the line of levels of 159.6 miles was made. Each mile of the line was run over at least twice. The actual amount of running done by the leveling party was 341 miles. There is no record of leveling ever having been done more rapidly than this in any country of the world.

The last few days of the fiscal year 1916 were occupied by a precise leveling party in setting bench marks along a line of levels which was to extend from Boundary to Vanceboro, Me. The observations were begun early in the fiscal year 1917 and were completed before the winter of that year. This line of levels was run for the purpose of strengthening the combined network of precise levels of the United States and Canada. In addition to its usefulness for this purpose, it furnishes fundamental elevations of a number of bench marks in the State of Maine which can be used to control surveys, maps, and engineering work.

When the party which had been working in Maine completed the line in that State it was transferred to Rouses Point, N. Y., where it began running a line toward Troy. Before the winter weather set in this line had been extended as far south as Whitehall, N. Y. It had been planned that this line should be completed during the spring of 1917 but the work had to be postponed on account of calls upon the Survey by the War Department.

Upon the request of the United States Geological Survey a line of precise levels was run during the fall and early winter of the fiscal year, from Clovis, N. Mex., to Pecos, Tex. Leveling along this line was needed to furnish the fundamental elevations for the control of topographic maps which will be made by the United States Geological Survey. The line began at a precise leveling bench mark which had previously been established on the Santa Fe Railway and ended at a bench mark which had previously been established on the Texas & Pacific Railway.

During the early spring of 1917 a line of precise levels was run from Washington, D. C., to Indian Head, Md., by way of Upper Marlboro and La Plata. A spur line was run from La Plata to Popes Creek, which is a railroad station on the Potomac River at the end of the Popes Creek branch of the Pennsylvania Railroad. This line of levels was run in compliance with a request from the Navy Department.

In May, 1917, a precise leveling party of the Survey began running a line of precise leveling between Escanaba and Marquette, Mich. Upon the completion of this line the party moved to the vicinity of Detroit, where a line was run from that place to Algonac. The work on this line was nearly completed at the end of the fiscal year. The work done in Michigan by this party was called for by the United States Lake Survey.

There was more leveling done by the Coast and Geodetic Survey in the fiscal year 1917 in the extension of the precise level net of the United States than in any other year in the history of the Survey. The total amount of precise leveling done was 2,930 miles.

On nearly all of the work done during the fiscal year the chief of party had his instrument mounted on the motor car and the observations were recorded on a listing adding machine. These two ways of working in precise leveling were innovations in the year 1915 and their continued use has proved that they add to the efficiency of the precise leveling work.

The new level rods mentioned in the report for the fiscal year 1916 were used exclusively, or almost so, on the leveling done during the fiscal year 1917. They proved to be a great improvement over the old wooden rods and it is expected that they will be continued in use on all future leveling. During the latter part of the fiscal year 1917 it was necessary to make some metal rods with steel strips instead of the strips of nickel steel. This was made necessary because of the inability of the office to procure invar, or nickel steel metal, as the factories which ordinarily furnish it were engaged entirely on work connected with war munitions.

Astronomic work was done during the year by the triangulation parties and also by the traverse parties. The work consisted in the determination of the azimuths of certain lines of their schemes.

Separately organized parties were engaged upon the determination of the astronomic longitude at a number of places in Oregon, Washington, Idaho, Utah, Nevada, and California. In this work the Survey was greatly assisted by officials of the Western Union Telegraph Co., who permitted our observers to use their wires when exchanging time signals between their observatories.

All of the astronomic work mentioned above was done for the purpose of controlling the azimuths in the triangulation and primary traverse at the stations at which the astronomic observations were made. These astronomic observations will also be of value in any future determination of the figure of the earth and in investigations made to determine the probable distribution of material in the outer portions of the earth.

Two parties of the Survey operated on the western coast of the United States during the first part of the fiscal year 1917 in the determination of the intensity of gravity at a number of places in the States of California, Oregon, and Washington. The purpose of this work was to collect data for an investigation of the distribution of materials in the earth's crust along the Pacific coast and, if possible, to throw some light on the conditions existing along the fault line which formed at the time of the San Francisco earthquake.

A party was engaged during the latter part of the fiscal year in the determination of the intensity of gravity at certain places in West Virginia, New Jersey, and Connecticut. This work was done in response to a request from the chief geologist of the United States Geological Survey. It had been planned to extend greatly the work of this party, but shortly after the beginning of the work it was found necessary to curtail the season's work in order that the chief of that party might be engaged on work of a different nature called for by the Corps of Engineers, United States Army.

Tertiary triangulation was done at a number of places during the fiscal year. In Alaska such work was done by subparties working under the chief of a combined party. In practically all cases where work was done in tertiary triangulation on the coast of the United States it was by parties organized especially for the purpose.

A party which had been operating on the coast of California during the latter part of the previous fiscal year in determining the geographic positions of objects on shore, which were to be used by officials of the Bureau of Lighthouses when placing buoys, completed its work early in the fiscal year 1917.

A party operated, for a short time, in the States of Washington and Oregon, in the determination of the geographic positions of certain wireless towers in compliance with the request from the Navy Department.

A determination of the geographic position of a wireless tower was made by one of the gravity parties which was operating during the early part of the fiscal year on the Pacific coast. This station was located at Marshfield, Oreg.

The inspector of the Coast and Geodetic Survey, located at Galveston, Tex., determined the geographic positions of the wireless towers at certain stations along the coast of Texas during the fiscal year.

A party was organized early in the spring of 1917 which determined the geographic positions of a number of wireless towers at places on the Atlantic coast to the northward of Annapolis, Md.

A second party was organized early in the spring of 1917 and determined the geographic positions of a number of wireless towers on the Atlantic coast to the southward of Norfolk, Va., and along the Gulf coast in Louisiana and to the eastward.

A party was engaged during a part of the winter of the fiscal year 1917 in making a tertiary triangulation in the District of Columbia and that part of Maryland just to the northward of it in compliance with a request from the Washington Suburban Sanitary Commission. The results of this triangulation were used by that commission for controlling certain surveys that it was making in the State of Maryland.

During the winter of the fiscal year 1917 a party of the Survey made a tertiary triangulation of San Francisco Bay and its tributaries for the primary purpose of furnishing control for the wire-drag surveys which were carried on simultaneously with the triangulation. The results of this triangulation will be of value, also, in furnishing the geographic positions of a number of the objects which may be used as aids to navigation and to control hydrographic and topographic surveys which may be made in the future. The party engaged on this work reported that a number of the old stations had been found to be destroyed by the erosion of the shores or the development of the land for commercial and industrial purposes.

During the spring of 1917 a triangulation party worked in the vicinity of Charleston, S. C., recovering and re-marking old triangulation stations and locating prominent objects which might be used as aids to navigation and for control points for maps and surveys.

#### DIVISION OF TERRESTRIAL MAGNETISM.

Except for a visit of inspection to the Cheltenham Observatory the duties of the chief of this division have been performed at Washington. His duties include the preparation of plans, estimates, and instructions for the field work; the inspection of the records as they are received; recommendations regarding the purchase, construction, and repair of instruments, and the construction and alteration of observatory buildings; supervision of the office computations and preparation of results for publication; discussion of results.

#### MAGNETIC SURVEY.

The magnetic survey of the United States has now reached the point where most of the field work is confined to the occupation of repeat stations and the investigation of areas of local disturbance. During the past year observations were made at 319 stations in 29 States, of which 148 were new primary stations, 120 auxiliary stations, 40 repeat stations for the determination of secular change, and 11 new stations in old localities. Meridian lines were established when they were requested by the local authorities. The number of county seats at which magnetic observations have not been made was reduced from 240 to 163.

Observations were also made (declination only in most cases) at a number of places in Alaska and the Philippine Islands in connection with other branches of the work of the Survey. The observations at sea were confined to those needed for the determination of the deviations of the ship's compasses.



## DISTRIBUTION OF STATIONS.

State.	New stations.		Repeat stations.	New station in old locality.	Total.
	Primary.	Auxiliary.			
Alabama.....			1		1
Arkansas.....	5	6	2		13
California.....	9		1		10
Colorado.....	6	4	3		13
Florida.....	2		1		3
Georgia.....			2		2
Idaho.....	21	9	1		31
Illinois.....	2		1		3
Indiana.....			1		1
Kansas.....	4	14	3	1	22
Maine.....	5		2		7
Mississippi.....			1		1
Missouri.....	27	23	4		54
Montana.....	15	22	3		40
New Hampshire.....	2	1	2	1	6
New Mexico.....	8	8	1	1	18
New York.....	6	14	2	1	23
North Dakota.....	7				7
Oklahoma.....	2			1	3
Oregon.....	8		1		9
Porto Rico.....				3	3
South Carolina.....	1	8		2	11
South Dakota.....	5		1		6
Tennessee.....	5		3	1	9
Texas.....			1		1
Utah.....			2		2
Vermont.....	3	7			10
Washington.....	9	4	1		14
Wyoming.....	1				1
Total.....	148	120	40	11	319

## MAGNETIC OBSERVATORIES.

The observatories at Cheltenham, Md., Vieques, P. R., Tucson, Ariz., Sitka, Alaska, and near Honolulu, Hawaii, were in operation throughout the year. Continuous photographic records were secured of the variations of declination, horizontal intensity, and vertical intensity. Absolute observations were made at least once a week and scale-value determinations once a month. A seismograph was kept in continuous operation at each observatory, the number of earthquakes recorded being below the average.

All of the magnetic instruments used in the field work were standardized at Cheltenham. In addition comparisons were made between the earth inductor at that observatory and the one from the Porto Rico observatory and also one belonging to the department of terrestrial magnetism of the Carnegie Institution of Washington, the results agreeing closely with previous comparisons of the same instruments.

At Cheltenham much time was devoted to study of the instruments in use with a view to eliminating outstanding differences between the absolute instruments and the two magnetographs. A new method of placing the earth inductor accurately in the magnetic meridian and a modification of the rotating mechanism produced a decided improvement in the vertical intensity results, but the horizontal intensity differences appear to be due to the variometers rather than to the magnetometer. A change in the adjustment of No. 5 variometer was made just at the end of the year, the full effect of which has not yet been determined.

The new building for office and quarters at Sitka was completed near the end of November and the observer moved in on December 6. With the consent of the owner of the Swanson property the absolute building has remained in its original location through the winter. This summer the old blockhouse on the reservation on which the variation building stands will be torn down and the absolute building will be moved to that site.

The repairs to the Cheltenham variation building in progress at the end of the last fiscal year were completed and necessary repairs were also made to the shop and windmill. At the end of the year the necessary materials were purchased for re-covering the roof on the variation building and painting all of the buildings. Work is in progress on plans for a new building for office and quarters, the need for which was pointed out in last year's report. At the Porto Rico observatory extensive repairs had to be made because of the damage done by the hurricane of August 22, 1916. The living and sanitary conditions have been much improved by the installation of plumbing and a sewage disposal system.

#### APPROPRIATIONS AND DISBURSEMENTS.

The appropriation made by Congress for the United States Coast and Geodetic Survey in the sundry civil act for the fiscal year ended June 30, 1917, was \$1,227,140, divided as follows:

Field expenses.....	\$425, 320
Repairs and maintenance of vessels.....	58, 000
Officers and men, vessels.....	285, 000
Pay of field officers.....	184, 900
Pay of office force.....	213, 420
Office expenses.....	62, 500
<b>Total.....</b>	<b>1, 227, 140</b>

For the fiscal year ending June 30, 1918, the total amount appropriated is \$1,379,970, and the items of appropriation are as follows:

Field expenses.....	\$487, 600
Repairs and maintenance of vessels.....	58, 000
Officers and men, vessels.....	320, 000
Pay of field officers.....	223, 500
Pay of office force.....	220, 770
Office expenses.....	67, 500
Offset attachment for lithographic press.....	3, 000
Paper-cutting machine.....	1, 600
<b>Total.....</b>	<b>1, 379, 970</b>

#### DETAILS OF FIELD OPERATIONS.

##### HYDROGRAPHIC AND TOPOGRAPHIC WORK, ATLANTIC COAST.

##### MAINE AND NEW HAMPSHIRE.

[JOHN H. PETERS.]

**SUMMARY OF RESULTS.**—Hydrography: 107 square statute miles dragged; 120.5 miles run while dragging, 4,955 angles taken while dragging, 56 soundings retained, 1 tidal station established, 4 tidal bench marks established, 1 current station established, 26 aids to navigation determined.

Under instructions of March 6, 1917, a party was organized for wire-drag work in the approaches to the harbor of Portsmouth, N. H.

Work was begun at Portsmouth, N. H., on April 17. This consisted in overhauling the machines and other drag equipment and in the organization of the party. The chartered launches reported between April 25 and May 1. Drag work began May 11 in the approaches to Portsmouth Harbor.

From May 11 to June 30, general drag work was done, subject to the general inclemency of the weather, in Portsmouth Harbor and in the area between the entrance to Portsmouth Harbor and the Isles of Shoals, Me.

#### MAINE, PENNSYLVANIA, AND MARYLAND.

[R. F. LUCE.]

In November an inspection was made of the tide stations at Portland, Me., Philadelphia, Pa., and Baltimore, Md.

Necessary repairs were made to the apparatus, and connection made by leveling between the gauges and permanent bench marks.

All of the gauges were left in satisfactory working order.

The field work of the party engaged in tidal and current work in Long Island Sound was inspected and a visit was made to the party engaged in wire-drag work in the vicinity of Beverley. The suboffice at New York was visited.

Officers of the United States Engineers and Lighthouse Service at Portland, Me., Boston, Mass., New Haven, Conn., New London, Conn., and Philadelphia, Pa., were consulted in regard to tidal and current observations and much information was received from them.

In Boston the chairman of the marine committee of the Boston Chamber of Commerce was consulted in reference to the proposed establishment of tidal indicators in Boston Harbor. On November 13 an exhibit illustrative of the work of the Survey was made at the meeting of the National Academy of Sciences at Boston, Mass.

#### MASSACHUSETTS.

[N. H. HECK.]

SUMMARY OF RESULTS.—Triangulation: 175 square miles of area covered, 7 signal poles erected, 8 stations in main scheme occupied for horizontal measures, 7 stations in supplemental schemes occupied for horizontal measures, 13 stations occupied for vertical measures, 136 geographic positions determined, 50 elevations determined trigonometrically. Levelling: 4 miles of levels run, 12 permanent bench marks established. Topography: 50 miles of general coast line revised (chart revision work). Hydrography (wire-drag work): 200 square miles of area dragged, 12,921 positions determined (double angles), 659 soundings made, 13 current stations occupied, 4 hydrographic sheets finished and 1 partly finished, scales 1:10,000 and 1:25,000.

Wire-drag work in the region between Boston and Cape Ann, Mass., was in progress on July 1. Progress up to that date is reported in the annual report for 1916.

The plan of the season's work included the completion of all area between the 25-fathom curve and certain inshore limits, from the work of the previous season in Boston Bay to the vicinity of Cape Ann. This area presented the widest possible range of conditions with the exception that the area of excessive currents was very limited. A very large percentage of the area was suitable for the use of the longest drag possible for the launches to operate. On the other hand, the greater part of the area inside of the 10-fathom curve

was of the most broken character possible, where the continuity of the dragging was interrupted by the constant discovery of uncharted shoals and by the presence of lobster pots, and the length of the drag was limited by known ledges, islands, or buoys.

In order to make the rate of progress reasonably uniform for all classes of work, a definite method of procedure was adopted with satisfactory results. The comparatively deep offshore area was not marked out in any way though an effort was made to inform trawl fishermen of the general locality in which work was being done. This area was dragged with a 15,000-foot drag whenever the conditions of sea and atmosphere permitted. The inshore areas were marked off in sections as usual and notices were issued for attachment to posted charts. Such areas were dragged on days when conditions were not suitable for work offshore. The extensive shoal areas in Salem Harbor did not permit this treatment, and consequently were deferred till the latter part of the season and then dragged continuously.

Two changes of base were made during the season, though only two harbors, Beverly and Gloucester, were used. Beverly was selected in preference to Salem or Marblehead as it was the only one with wharves at which there was sufficient water and which had suitable buildings for housing the gear and for repair work.

Work was nearly completed within the limits outlined for the season and would have been entirely completed had it not been for the extension of the dragging of Jeffreys Ledge and the investigation of Sandy Bay and approaches for use of naval vessels. The unfinished areas outlined in the original instructions are of small extent and of little importance to navigation. They include two sections near Nahant, Marblehead Harbor, several small areas in Salem Harbor approaches, and part of the area between Thatcher Island and Straitmouth Island. Otherwise all area assigned was completed to Halibut Point, the northern extremity of Cape Ann. Four sweeps were made on Jeffreys Ledge.

In the deep-water work, where the general depth ranged from 12 to 30 fathoms, only two obstructions were found and both of these were wrecks at a depth of about 20 fathoms, the wire catching on the masts or rigging.

In the inshore areas the uncharted rocks and shoals found were so numerous that only the results can be mentioned.

Salem Harbor is one of the oldest in New England and the city was at one time the fourth in size in the United States and had at one time a very large foreign trade. It has also been an important harbor of refuge from the earliest times, being considered preferable to Gloucester for vessels bound around Cape Cod for points to the westward in certain conditions of wind, especially before the construction of the breakwater at Gloucester. It is learned this year that even the moderate-draft vessels of the earlier times were often in danger of striking. It does not appear probable that square-rigged sailing vessels could have always held closely to their chosen courses in entering through narrow channels in the days before towboats, and they were therefore passing close to many unknown dangers.

A few years ago the North Atlantic fleets held maneuvers outside of Salem and used the harbor as an anchorage. This year it was found that they daily had a choice similar to the famed Scylla and

Charybdis in the form of a 20-foot rock close to the deep channel on either side. Both Salem and Beverly have important industries, of which probably the largest is the United Shoe Machinery Co., at Beverly. The numerous large factories in this vicinity use an immense amount of coal which is brought in by vessels, either deep-draft barges or by 5,000-ton steamers drawing 24 feet. In addition to this the Gulf Refining Co. has a large plant at Beverly and their vessels of similar tonnage and draft must be brought to their dock. The fact that these vessels, arriving weekly or oftener, reach their docks in safety under the conditions discovered this season, which proved that they passed dangerously close to rocks beneath them and on both sides while making a sharp turn in a very narrow channel, shows very skillful pilotage and an inexplicable immunity which can only be called luck.

From Bakers Island to Cape Ann it was found that deep-draft vessels must keep outside of a fixed line parallel to the shore. Gloucester Harbor was found to contain not only a number of uncharted rocks but a considerable number of anchors, some of large size. The region surrounding Londoner shoal was found to be rocky with shoal depths over a larger extent than the chart showed, with much reduced depth in numerous places. The channel between this shoal and Thatchers Island was found to have a maximum depth of 20 feet instead of the 40 feet formerly indicated. In the south approach to Sandy Bay several shoals were found which restricted deep-draft vessels to the north approach, as the latter was proved free from obstruction.

In Salem Harbor 49 new soundings all less than charted were found in a single square mile.

In the offshore area the depth to be verified was 50 feet. Inside of certain well-defined limits 33 feet was adopted. This was afterwards modified to 35 feet for Salem Main Ship Channel and the part of the harbor likely to be used by battleships.

Some experimental work was done to test the accuracy of the drag under varied conditions.

The amount of topographic work required was not great, as the charts were found to be in good condition in this respect. A launch cruised along the coast making observations as to changes, and information was obtained in Boston to bring the charts up to date. In Gloucester the United States Engineers furnished some information to bring the charts up to date.

Tides were observed at Beverly and Gloucester on days when drag work was not done, and readings were obtained from the gauge at Nut Island.

Current observations were made from a small launch hired for the purpose. Observations were made almost daily from August 1 to September 1. Thirteen stations at intervals between Nahant and the Dry Savages were occupied. A simple apparatus was devised and used for observing tides in the immediate vicinity of the current stations.

Additional soundings were found necessary in some areas and these were obtained with a sounding machine constructed for the purpose which proved efficient up to 50 fathoms.

The triangulation revision included primarily the determination of objects for use in connection with the wire-drag operations. The

chief purpose of the revision was to determine objects from the limits of the previous season's work to the end of Cape Ann. It was found that with very little additional expense this work could be extended to the field of the previous season's work and to the westward and northward of Cape Ann and include a complete revision and recovery of stations.

At the close of the season two quadrilaterals had been completed for the determination of 3 new stations, and 32 stations had been occupied for the determination by intersections of 136 objects. Of the marked stations 21 were recovered and re-marked when necessary.

In addition to this work the positions of radio towers at Boston and Portsmouth were determined.

Improvements in wire-drag apparatus made during the season include a new type of small buoy; a dog with spring clamp that holds the ratchet which prevents the buoy from turning; an improved arrangement of the towline on the guiding launch; an improvement in the air signaling system; the installation of a stationary engine in place of a marine type of engine and the installation of the discarded engine on the end launch, which proved advantageous in taking up the drag; an improvement in the small sinker; the discontinuance of the use of the fathom as a unit of measure in wire-drag work, and the standardization of the apparatus used in measurements.

Information was obtained from fishermen and others on the coasts of Maine and Massachusetts as to possible shoal depths on the banks of the Gulf of Maine.

A device for shoal-water diving was purchased and investigated.

Much local interest was shown in the work of the party. The Chamber of Commerce of Salem was represented by a committee who visited the party while at work, and representatives of various newspapers inspected the work and prepared articles on the subject.

The passage through the drag of a submarine while submerged was an occurrence of interest. In general traffic passed through the drag without inconvenience except on one occasion when a schooner carried away the large buoy and the launch attached to it. After some difficulty, due to inability to stop the schooner, the buoy was recovered.

#### MASSACHUSETTS AND NEW YORK.

[J. H. HAWLEY.]

**SUMMARY OF RESULTS.**—Triangulation: 15 square miles of area covered, 4 signal poles erected, 7 stations in supplemental schemes occupied for horizontal measures, 10 geographic positions determined. Topography: 23 miles of general coast line surveyed, 7 miles of shore line of creeks surveyed, 2 miles of roads surveyed, 1 topographic sheet finished, scale 1:20,000. Hydrography: 37 square miles of area covered, 534 miles run while sounding, 4,489 positions determined (double angles), 21,648 soundings made, 4 tide stations established, 4 current stations occupied, 2 hydrographic sheets finished, scale 1:10,000. Wire-drag hydrography: 175 square miles of area dragged, 1 current station occupied, 323.1 miles run while dragging, 58 retained soundings, 2,135 positions determined, 3 tide stations established; scales of wire-drag sheets, 1:30,000 and 1:40,000.

On July 1, 1916, wire-drag party No. 2 was located at Plymouth, Mass., and operations were carried on from that base. It was found that the boulder formation, which resulted in the discovery of numer-

ous important shoals during the 1915 season, does not extend south of Plymouth Bay and few obstructions were found except in areas close to shore.

The work was carried to the southward as far as it could be prosecuted economically from Plymouth and on July 12 the party changed headquarters to the eastern end of the Cape Cod Canal. A workshop and office were obtained at the Cape Cod Canal Co.'s coal yard at Sandwich and the members of the party secured living accommodations at Sandwich and Sagamore. No regular mooring place could be obtained for the launches and it was necessary to keep men aboard them at all times so that they could be shifted about and kept clear of the traffic through the canal.

The difficulty of navigating at close quarters in the canal because of the strong currents, and the unreliability of the mooring dolphins which are constructed of wooden piles and are frequently carried away by vessels or by the current, made the position of the launches unsafe at all times, and the canal could not be considered as a suitable or satisfactory working base except for its nearness to the working grounds.

The work progressed rapidly and was completed on August 16. In addition to the work originally assigned a wire-drag survey of Fishing Ledge was made.

Tidal bench marks were recovered and reestablished at Cohasset, Scituate, Plymouth, and Sagamore Beach.

The weather conditions during July were rather unfavorable and work was prevented by strong winds or fog on 10 days. The most rapid progress was made during August when the weather became more favorable and about 50 square miles were dragged in 9 days.

Very little trouble was caused by lobster fishing operations compared with that of previous seasons.

The outfit was loaded on the launches on August 17 and on the 18th the party left the canal en route to Fort Pond Bay, N. Y., to take up the survey of the western part of Block Island Sound and vicinity.

The party and launches arrived at Fort Pond Bay on August 19 and established headquarters at Montauk, N. Y. Fort Pond Bay was found to be a satisfactory harbor for the launches, except in north to northwest winds to which it is entirely exposed.

Tide staffs were established at Fort Pond Bay and at Montauk Point. Several triangulation stations were recovered and four large tripod signals were erected. Some triangulation was done to provide additional objects for the control of the work.

Dragging operations were started on August 23 and continued until October 6, after which date it was not considered economical to work in exposed waters.

A considerable area was examined with the drag and several shoals were found and reported. The requirements of submarine vessels were considered and in the deeper parts of the Sound the drag was set at a considerably greater depth than is customary.

On one day an area of 20 square miles was covered with a 12,000-foot drag towed by two launches.

On October 9 and 10 the party changed headquarters to Greenport, N. Y., and began the survey of Gardiners Bay.

The work in Gardiners Bay was continued until November 10 when it became necessary to discontinue operations on account of

bad weather. Practically all of the unobstructed part of Gardiners Bay was dragged and some work was done in Plum Gut. The inshore limits for the western part of the bay were defined by the limits of the oyster beds which are marked out by numerous stakes. Tidal observations for the reduction of this work were made on a staff at Long Beach Bar Lighthouse.

In addition to the wire-drag work, tidal bench marks were recovered and established at Montauk Point, Fort Pond Bay, Long Beach Bar Lighthouse, and Deering Harbor. The topography of Fort Pond Bay was revised and a dredged channel from Gardiners Bay into Three Mile Harbor was investigated and located. Current observations were made on one day at Shagwong Reef Buoy. A search was made for a reported rock in the channel west of Shelter Island and two boulders were found and located.

The efficiency and usefulness of the wire drag is well shown by the discovery of these rocks. The letter directing the search for these rocks was received at 8 a. m., and the person who reported their existence was found about two hours later on a fishing boat in Gardiners Bay. From Gardiners Bay the party proceeded to the reported location of the rocks and set out the drag. The rocks were found and located, the party returned to Greenport, the work was plotted, and a full report was mailed at 3 p. m. These rocks were of small extent and surrounded by level, sandy bottom. Even their approximate position could not be given by the person who reported them and it would probably have required close development with the lead and line for one or two days before they could have been found without the drag.

The weather conditions for the work in this region were generally satisfactory. The principal causes of delay and interference with the work were the very strong currents, heavy swell, and extensive fishing operations. Lobster traps were very troublesome.

The inshore areas in this region are obstructed by numerous fish-weirs, and in Gardiners Bay some trouble was experienced with oyster stakes and with the torpedo tests conducted by the Navy and by private firms.

The effects of the strong currents, swell, exposed nature of the work, and obstruction by fishing gear are well shown by contrasting the area of 84 square miles covered in this region with the 168 miles dragged in Cape Cod Bay during practically the same length of time.

The three launches used by the party gave satisfactory service.

The change in design of the reel, by attaching the brake to the reel drum, proved to be very satisfactory.

The Roebling method of attaching the sockets to the bottom wire proved to be the solution of a problem which had given considerable trouble in the past.

A semaphore apparatus was devised, constructed, and successfully used to replace the wigwag signal system.

The topographic work of the subparty under I. M. Dailey in Plymouth Harbor, Mass., and vicinity, in progress at the beginning of the fiscal year, was completed on July 22.

The hydrographic work was begun with a chartered launch on July 24 and continued to completion on September 30. In accord-



ance with instructions issued September 6 the hydrographic work was extended from Gurnet Point up the coast to Green Harbor.

Tidal observations were made in Green Harbor, Duxbury Bay, and Black River to supplement the observations on the main staff at Plymouth, and bench marks were established at these points.

Current observations were made in the vicinity of Gurnet Point, Plymouth Harbor, and Green Harbor.

#### RHODE ISLAND.

[R. P. STROUGH.]

**SUMMARY OF RESULTS.**—Triangulation: 36 square miles of area covered, 14 signal poles erected, 10 stations in main scheme occupied for horizontal measures, 1 station in supplemental scheme occupied for horizontal measures, 38 geographic positions determined. Leveling: 4 permanent bench marks established, 1 mile of levels run. Topography: 12.1 miles of shore line of rivers surveyed, 1 topographic sheet partly finished, scale 1:10,000. Hydrography: 65.3 square miles of area dragged, 78.1 miles run while dragging, 17 soundings retained (depths less than charted), 18.5 square miles of area sounded, 145.6 miles run while sounding, 831 positions determined (double angles), 4,494 soundings made, 1 tide station established, 1 hydrographic sheet finished, scale 1:10,000.

On April 16, 1917, arrangements were made for organizing and equipping a party for wire-drag work in Block Island Sound. The party was organized at Greenport, N. Y., between April 20 and 25 and on April 28 the party moved from Greenport to Sakonnet, R. I. Actual drag work was begun on May 2, and carried on until May 27 in the vicinity of the eastern approach to Narragansett Bay, except for the period from May 3 to 26, inclusive, when the entire party was engaged in experimental work in regard to certain phases of wire-drag work under the direction of three officers of the Survey.

On May 27 offshore work was discontinued and the party took up a revision survey of Sakonnet River, including triangulation and topography. This work was carried on during the period from May 27 to June 14, and was then discontinued.

On June 15 the party resumed wire-drag work in the eastern approach to Narragansett Bay, and on days when the weather would not permit dragging operations in that vicinity the revision survey of the Sakonnet River was continued.

As the depths to be verified in the offshore dragging have been increased to a maximum of 85 feet certain minor changes in the wire-drag gear have become necessary. The old wooden floats have been found to be unsuited to this deep work because they water-log very rapidly under the high pressure and they are being superseded by metal floats of a design which was recently submitted to the office. The new style small buoys designed by N. H. Heck are now used in place of the smaller can buoys of the old style and have been found satisfactory in every respect.

#### RHODE ISLAND, CONNECTICUT, AND NEW YORK.

[PAUL M. TRUEBLOOD.]

**SUMMARY OF RESULTS.**—Leveling: 32 permanent bench marks established. Hydrography: 11 tidal stations established, 2 current stations occupied.

On May 24, 1917, arrangements were made to begin work on a current and tidal survey of Long Island Sound.

New London was selected as the headquarters of the party.

Two launches were hired for the use of the party, both being equipped with heavy anchors and wire cable for anchoring in deep water and swift currents.

An automatic tide gauge was installed on the lighthouse wharf at New London June 5 and operated continuously till the end of the month. A satisfactory record was obtained.

An automatic gauge was installed at the city dock, foot of Hamilton Street, New Haven, and operated continuously till the end of the month.

Auxiliary tide staffs were put in place and determined by comparative readings at Allyn's Point and Norwich on the Thames River, at Mystic, Stonington, Westerly, and Niantic; and at Hartford, Higganum, and Hadlyme on the Connecticut River.

The tidal variation in the Thames River is very distinct as far as Norwich and it is believed that the comparative readings give a good determination of the Norwich staff.

The main channel of the Connecticut River is tortuous and constricted. The tidal variation is so affected by the flow of fresh water downward as to disappear entirely at a certain stage of the river which varies with the distance from the Sound. It is known locally that the tidal variation is from 0.7 to 0.9 foot at Hartford when the river is not more than 2 or 3 feet above the Hartford city datum. The river at times rises to a height of 25 feet or more above datum and may stand for weeks above the 7-foot stage.

Current observations were made from the New York, New Haven & Hartford Railroad bridge at New London for a period of 30 hours. Observations were made at depths of 3 feet, 18 feet, and 42 feet.

At Norwich a 25-hour series was made from an open boat.

Permanent bench marks were established or recovered in connection with every tide gauge. Three marks, one of which was a standard disk mark, were left at every station.

The tidal records were obtained with a special form of pressure gauge.

#### RHODE ISLAND, CONNECTICUT, NEW YORK, AND NEW JERSEY.

[ISAAC WINSTON.]

Inspection duty for the region included between Narragansett and Delaware Bays was continued by an officer who is in charge of the suboffice of the Survey in the Customhouse Building, New York.

The demands upon the suboffice for information cover a wide range of subjects including work by many departments of the Government besides that of the Coast and Geodetic Survey. All available publications bearing upon navigation and useful to mariners are kept as reference books, and those issued without charge are kept on hand for distribution. The publications of the Bureau of Lighthouses are in constant demand, and a supply is kept on hand.

Requests for other publications are referred to the proper departments or institutions.

Information in regard to the time of moonrise and moonset was furnished to the branch hydrographic office at New York.

Important information and assistance was rendered to the corporation counsel of New York City in the preparation of a case involving the title to certain land on the north shore of the Harlem River.

The inspector appeared as a witness in court in this case. The hearings extended over a month.

Information has been furnished in reply to numerous requests in regard to the times and heights of the tides and times of slack water. Tables have been prepared to show the times of high and low water at Sandy Hook, Governors Island, and Hell Gate Ferry (Astoria) for 1917, also tables showing sunrise and sunset and moonrise and moonset for 1917 in the form required for printing, and this information is printed daily in 11 of the principal newspapers published in New York City. Similar information has been furnished to other newspapers and to the New York Maritime Exchange.

Repairs were made to the electric tide indicators at the Seaman's Friend Institute and at the New York Maritime Exchange and also to the tide station at Fort Hamilton, N. Y.

Information was obtained for chart correction and for a revised edition of the Table of Depths.

A stock of charts, coast pilots, and tide tables is kept on hand at the suboffice for sale to persons applying for them. Charts were supplied without charge to Government officials requiring them, and to sales agencies upon request, to meet emergencies.

A clerk was assigned to the suboffice on September 19 and has rendered useful assistance.

Assistance was given to officers of the Survey engaged on field work in the vicinity of New York and to the officer in charge of the Coast and Geodetic Survey exhibit at the National Motor Boat Show.

The inspector attended the United States courts as an expert witness on three occasions to explain the charts and furnish information as to tidal conditions in cases involving claims for damages.

In May a determination was made of the geographic position of the Woolworth tower, New York City, and of the Staten Island Lighthouse by triangulation.

Charts were furnished for official use to meet the immediate demands of the military and naval authorities and other Government officials.

#### CONNECTICUT AND NEW YORK.

[F. S. BORDEN.]

**SUMMARY OF RESULTS.**—Hydrography: 3 tide stations established, 13 subsidiary tidal records obtained, 15 current stations occupied.

On July 31, 1916, instructions were issued for a complete tidal and current survey of Long Island Sound from the vicinity of Execution Rocks to the eastward.

In accordance with these instructions a party was organized at Oyster Bay, N. Y., and field work was begun on August 5.

Current observations were made as far as possible at stations indicated in the instructions although several of these stations were omitted when, after a few hours' observations, it was found that the maximum current was so small that it could not be measured with any degree of accuracy.

Whenever possible observations were made at each station for 51 consecutive hours. The first four stations occupied were completed

without a break in the observations. As the season advanced, however, and the weather became more unsettled, it was often necessary to occupy stations two or three times before the necessary observations could be obtained.

Practically all of the stations occupied were referable to definite objects on the shore, and their positions were determined by sextant angles. At night and during thick weather the direction of the current was obtained by pelorus and compass.

All observations were made with the current pole and line. The velocity as obtained with the sand glass and current line was often checked by measuring with a stop watch the time it took for a carefully measured length of line to run out and computing the velocity. The current pole used at most of the stations was 15 feet in length.

In general, in making current observations for 51 consecutive hours, two persons made the observation from 12 noon until 12 midnight, when they were relieved by two others who made the observations from 12 midnight to 12 noon.

At the entrance to Port Jefferson Harbor the maximum current was found to be 3.4 knots on the flood tide and 2.8 knots on the ebb tide. The exact time of slack water was readily observed.

From September 1 until the close of the season a subparty was engaged in observing the tides. Information as to tidal work done in this locality by the United States Army Engineers was first obtained in order to prevent duplication of tidal work and in order to connect the work of the two services.

An automatic tide gauge was installed at Oyster Bay and was in operation throughout the season, about three lunar months of observations being thus obtained. A second automatic gauge was installed at New Rochelle, N. Y., and was in operation for one lunar month, after which it was removed to Port Jefferson, N. Y., where it was installed and a lunar month of record obtained.

Tidal information was also obtained at all other important harbors in this locality. At places where no previous work had been done, tide staffs were erected and observations made every 15 minutes for a period of an hour before and an hour after the time of high and low water, covering four consecutive high and four consecutive low waters. These observations together with a comparison of the records taken from the automatic gauges were used in working out the tidal data for the subsidiary stations. At all tidal stations at least three permanent bench marks were established.

At 10 tidal stations the bench marks established were connected with those of the United States Army Engineers, and at seven stations they were connected with the line of precise levels run by the Army Engineers between Greenwich and New London, Conn. By request of the city engineer of Bridgeport, Conn., the bench marks established at that place were connected with the city bench marks. At Port Jefferson they were connected with bench marks of the United States Geological Survey. Great care was taken in the leveling.

All of the old Coast and Geodetic Survey bench marks between Execution Rocks and Bridgeport were inspected, and wherever necessary new ones were established.

A sufficient number of current stations was occupied to determine fairly well the tidal current in the important bays, passages, etc., between Execution Rocks and Bridgeport, Conn.

The tidal survey from Execution Rocks to Bridgeport was completed.

[R. P. STROUGH.]

**SUMMARY OF RESULTS.**—Hydrography: 44.5 square miles of area covered, 838.2 miles run while sounding, 5,454 positions determined (double angles), 32,431 soundings made, 2 tide stations established, 4 hydrographic sheets finished, scale 1:10,000.

On July 25 a party was organized at Southport, Conn., for a hydrographic resurvey of Long Island Sound.

A power launch was hired for the use of the party and arrangements were made for tidal observations in the vicinity of Bridgeport Harbor. Four plain tide staffs were erected for this purpose and connected by leveling with the United States Engineers' datum plane bench mark at Bridgeport, Conn.

The party having been organized and tidal observations arranged for, the actual hydrography was begun on August 3, and work on the Connecticut side of Long Island Sound proceeded without interruption until completed. Between August 6 and 15 the work of the party was temporarily in charge of F. B. T. Siems. The hydrography joined that of P. C. Whitney on the west side near the Norwalk Islands and continued eastward around Penfield Reef to Black Rock Harbor. Split lines were run between the lines on the old sheet, 100 meters or less apart, from the shore line to the 7-fathom curve, and all rocky or broken areas were developed very closely.

On September 23 the headquarters of the party was removed to Northport, Long Island, to take up the hydrography in the vicinity of Huntington and Oyster Bays.

The tide station at Lloyd Harbor New Lighthouse was recovered, a staff gauge set up, and observations were taken from October 25 to November 22.

The work on the Long Island side does not differ materially from that in Connecticut. Split lines at intervals of 100 meters were run and the uncertain areas developed closely.

The work extends from Lloyd Point eastward to the point on the chart marked Arthurs House and offshore to the 7-fathom curve, including the development of Huntington and Northport Bays and Huntington, Lloyd, Northport, and Centerport Harbors. One day was spent in developing an area off the spar buoy at the entrance to Oyster Bay. Triangulation data and revised shore line of Huntington and Lloyd Harbors were obtained from W. C. Hodgkins, who was engaged in revising the triangulation and topography in that vicinity.

The soundings taken between September 23 and October 24 are all referred to the automatic gauge maintained by F. S. Borden at Oyster Bay. All of the soundings taken after October 24 are referred to the tide staff at Lloyd Harbor New Lighthouse.

Special care was taken throughout this work to use all possible means of obtaining information regarding menaces to navigation.

Oystermen, fishermen, and yachtsmen were interrogated in regard to the areas with which they were familiar, and the entire stretch of shore line covered by the season's work was gone over closely with the launch or small boat at low tide for the purpose of finding and locating any outlying dangers which were visible at that time. Where found these dangers were carefully located by sextant angles and the positions plotted on the boat sheet.

The areas of rocky formation that were developed during the season were examined as closely as possible without a large expenditure of time and money. Surveys with lead and line in greater detail might disclose the existence of other dangers, but until the whole area has been examined with a wire drag it is impossible to say with absolute assurance that this much-traveled waterway is free from unknown and uncharted menaces to the safe navigation of ships.

#### NEW YORK.

[W. C. HODGKINS.]

**SUMMARY OF RESULTS.**—Triangulation: 20 square miles of area covered, 11 signal poles erected, 17 stations in main scheme occupied for horizontal measures, 61 geographic positions determined. Topography: 32 square miles of area surveyed, 5½ miles of creeks surveyed, 12½ miles of roads surveyed, 3 topographic sheets finished, scale 1:10,000.

The revision of the triangulation and topography of the north shore of Long Island eastward from Matinicock Point was taken up August 18 and continued until December 5, 1916.

Preliminary work began with a reconnoissance of part of the territory to be examined, the organization of a party, and arrangements for securing living accommodations and a suitable launch for the transportation of the party.

The first part of the season was devoted to the revision of the topographic features, while during the latter part the principal work was the new triangulation intended for the control of the surveys in Huntington and Northport Bays, although topographic revision was also continued at every suitable opportunity and often in direct connection with the field work of the triangulation.

Topographic work was begun in the vicinity of the village of Oyster Bay and then carried on for a few days on the shore of the Sound between Oak Neck Point and Frost Creek. Revision work was afterwards taken up at Matinicock Point, the western limit of the district assigned for immediate examination, and was extended eastward from that point.

In the revision of the shore line it was generally found more economical to make an entirely new outline survey rather than to select places where changes were thought probable and to work each way from such spots to junctions with unchanged portions of the coast. This was the case especially in reference to stretches of coast that had to be covered by planetable traverse on account of the lack of intermediate triangulation points.

Such changes as have taken place are due either to the forces of nature, acting through a period of some 30 years, or to human agency.

The natural changes found to have occurred are generally quite small. Exposed shores show a gradual wasting, ordinarily of no

great extent. The greatest change noted was at Lloyd Point where a new inlet had broken through the barrier beach eastward of the point and where there seems to have been a well-marked drift of the shore sands from eastward to westward. The extensive marsh lying between the barrier beach and the solid land of Lloyd Neck proper has also undergone considerable change. In 1885 that area was chiefly an open lagoon with numerous small and scattered marshy islets or bunches of marsh grass, while at the present time its character is that of a marsh intersected by numerous passages, though the marshes are still soft and are overflowed by every tide.

At the southeastern extremity of Lloyd Neck, on the sand point called East Beach, some natural changes have taken place. The end of that point south of the old Lloyd Harbor Lighthouse has cut away almost up to the building, while the beach farther north has increased considerably in height so that it is no longer covered by ordinary high waters and is practically a continuous part of the main body of Lloyd Neck.

Other changes on the coast examined consist chiefly of moderate wasting, sometimes amounting to about 20 meters, the most noticeable effect of which has been to destroy most of the old triangulation stations that were situated near the water or on the crests of bluffs.

The artificial changes that have occurred are largely in the way of improvements. Many portions of the coast have thus been completely transformed. In order to counteract the natural tendency to wasting of these improved shores from the effect of storms, most of the waterside estates have been protected by long stretches of masonry or concrete sea wall.

Great changes have also been caused by extensive sand-dredging operations which, beginning on the west beach of Eatons Neck some years before the date of the former survey, have been greatly extended not only in the original locality but also on the northwest shores of both Eatons and Lloyd Necks. These excavations have produced artificial harbors of considerable extent, though of varying depth, that may sometimes serve as refuges for small craft.

Between Matinicock Point and Lloyd Point the loss of most of the triangulation stations determined in 1833 (34) and in 1883 (84) had been supplied to a great extent by new triangulation executed in 1914 and 1915, but eastward of Lloyd Point there was no recent work and only a few of the old points had escaped destruction. Those which were left were not so situated as to afford proper control for the topography of Huntington and Northport Bays and it was therefore found necessary to provide additional triangulation in that section.

The only base for new work in that vicinity which was both practicable and convenient was the line Eaton 2 (1883)-Titus (1885). Both of those stations were recovered, as were also Eatons Neck Lighthouse, Lloyd Harbor (old) Lighthouse and Baldwin Tower, all of which had been determined in 1883 and which were connected with the work of 1916.

In this work 11 new stations of the main scheme and 58 new intersection stations were determined, so that there are now sufficient points available for fixing positions at almost any point within the area covered, except perhaps in some of the deep and narrow coves and on some parts of the outer coast of Eatons Neck.

At the close of the season the revision of the topography had been carried eastward from Matinicoek Point as far as the western side of Centerport Harbor, and on Eatons Neck the shore of West Beach and of the western side of the neck as far north as the inlet near the light-house had been resurveyed.

The greater part of the shore line of Oyster Bay and part of Cold Spring Harbor had been resurveyed in 1915 by another party, and the work in that section here described consisted in filling the gaps left by that party.

#### VIRGINIA.

[PAUL C. WHITNEY, Commanding Steamer *Bache*.]

**SUMMARY OF RESULTS.**—Triangulation: 60 square miles of area covered, 4 signal poles erected, 3 stations in main scheme occupied for horizontal measures, 4 stations in supplemental schemes occupied for horizontal measures. Leveling: 3 permanent bench marks established and short lines of leveling run to connect with tide gauge. Magnetic work: 1 sea station occupied for magnetic declination. Topography: 7.9 square miles of area surveyed, 31.5 miles of general coast line surveyed, 5 miles of creeks and inlets surveyed, 23.5 miles of railroads surveyed, 2 miles of roads surveyed, 2 topographic sheets finished, scale 1:30,000. Hydrography: 105 square miles of area covered, 1,002.8 miles run while sounding, 4,890 positions determined (double angles), 27,387 soundings made, two tide stations established, 1 hydrographic sheet finished, scale 1:30,000.

At the beginning of the fiscal year the party on the steamer *Bache* was engaged in surveys in the vicinity of Cape Henry. This work consisted of a detailed hydrographic survey of the entrance to Chesapeake Bay westward from a line joining Cape Henry and Fisherman Island to Thimble Shoal Lighthouse, and thence westward along the south shore to Sewall Point, including Willoughby Bay. Triangulation was executed to locate Thimble Shoal Lighthouse and a few doubtful topographic signals.

The launch hydrography and topography were executed by shore parties located during the first part of the season at Lynnhaven Inlet and the latter part at Willoughby Spit.

Ship hydrography was begun July 11 but was discontinued July 14 in order to receive a party of official photographers detailed from the office for the purpose of obtaining a series of still pictures of the several instruments used in the Survey and a series of moving pictures illustrative of the various activities of the Bureau. The photographers completed their work on August 9.

After a few days' signal building the vessel was tied up at the F. O. Smith Shipbuilding & Dry Dock Co. wharf for general repairs, while the surveying work was continued by shore parties in the vicinity of Lynnhaven Bay.

Instructions being received to cooperate with the Southern Commercial Congress to be held at Norfolk December 11 to 14, 1916, preparations were made to present as creditable a showing as possible. Exhibits of the various instruments were set up in the cabin, and field sheets and records were shown in an attractive manner where visitors could examine them. On December 11 the *Bache*, in company with other vessels of the Department of Commerce fleet, anchored off Hospital Point and was opened for inspection by members of the Southern Commercial Congress and other visitors. Everything possible was done to inform visitors of the scope and



activities of the Survey. On December 13 the *Bache* took part in a water parade, consisting of a review of part of the Atlantic naval fleet anchored off Old Point Comfort.

After the congress was over, the *Bache* made preparations to carry on additional hydrographic work at the entrance to Chesapeake Bay. The weather conditions were unfavorable and the work was discontinued under instructions from the Superintendent on January 9, 1917.

The field work of topography was finished November 24 and the launch hydrography completed October 20, with the exception of two days in December when an examination was made near Sewall Point.

[G. T. RUDE, Commanding Steamer *Isis*.]

**SUMMARY OF RESULTS.**—Triangulation: 10 square miles of area covered, 3 stations occupied for vertical measures. Magnetic work: ship swung for compass deviation at one station.

During the period from July 1 to December 31, 1916, the headquarters of the steamer *Isis* was at Norfolk, Va. From August 1 to December 19 the *Isis* was at the shipyard of the Old Dominion Marine Railway Corporation undergoing extensive repairs and alterations.

Field work was in progress from July 1 to July 12. This work consisted of triangulation for the location of leading marks for the Navy Department along the dredged channels into the port of Norfolk and of prominent artificial objects in the vicinity of the port of Norfolk for charting purposes for the use of navigators.

Such additional stations were established as were deemed necessary to locate all the desirable objects. The objects were then located by cuts from at least three triangulation stations.

During the time that the *Isis* was at Norfolk for repairs the computations and plottings of the work of the previous season were completed.

The *Isis* was swung for compass deviation in Hampton Roads on December 10.

On December 11 the *Isis*, together with five other vessels of the Department's fleet, the *Bache*, *Roosevelt*, *Fish Hawk*, *Orchid*, and *Dixie*, dressed ship for the Southern Commercial Congress and was open for visitors to the congress, and a special launch schedule was arranged for the convenience of the guests who visited the ships to view appropriate exhibits displayed on each.

On December 13 the *Isis*, with the Secretary of Commerce and the Superintendent of the Coast and Geodetic Survey on board, participated in a naval review of the Atlantic Fleet in Hampton Roads. The reviewing fleet was led by the *Mayflower*, with the Secretary of the Navy on board, followed, in the order named, by the *Isis*, *Yankton*, *Dolphin*, *Bache*, *Fish Hawk*, *Orchid*, and *Roosevelt*.

The vessels of the Department carried several hundred specially invited guests of the congress, and were followed by a large number of steamers and small motor craft.

On December 14 the congress adjourned and the *Isis* returned to the dock of the Old Dominion Marine Railway Corporation on the 15th.

## NORTH CAROLINA.

[N. H. HECK, Commanding Schooner *Matchless*.]

**SUMMARY OF RESULTS.**—Triangulation: 16.3 square miles of area covered, 4 signal poles erected, 2 stations in main scheme occupied for horizontal measures, 4 geographic positions determined. Leveling: 1 mile of levels run, 2 permanent bench marks established. Topography: 8 square miles of area surveyed, 4 miles of general coast line surveyed, 19.3 miles of shore line of rivers surveyed, 2 topographic sheets finished, scales 1:20,000 and 1:10,000. Hydrography: 10 square miles of area covered, 284.6 miles run while sounding, 1,774 positions determined (double angles), 12,612 soundings made, 2 tide stations established and 2 hydrographic sheets finished, scale 1:20,000.

At the time of the transfer of the command of the schooner *Matchless* on April 13, combined surveys were in progress in Albemarle Sound.

During the period from April 13 to May 4 the survey of Bull Bay and Scuppernong River was completed, and part of Albemarle Sound west of Laurel Point Lighthouse, Yeopim River and Creek, with approaches, was finished to connect with previous work. The limits of the topography and hydrography were somewhat different on this account.

On May 3 after completing comparative tide observations, the *Matchless* proceeded to Elizabeth City, arriving on May 4. Shortly afterward the chief of party was temporarily ordered to Washington.

The *Matchless* remained at Elizabeth City preparing for work in Pamlico Sound and was held there on account of lack of funds. Office work on records and painting and repairing the vessel were in progress during May. From June 2 to June 26 the command of the vessel was temporarily assigned to another officer.

At the close of the fiscal year the survey of Pamlico Sound was in progress. The principal signals had been built, the necessary triangulation executed, and a small amount of hydrography and topography had been done.

[PAUL M. TRUEBLOOD, Commanding Schooner *Matchless*.]

**SUMMARY OF RESULTS.**—Topography: 6 square miles of area surveyed, 18 miles of shore line surveyed. Hydrography: 91 square miles of area covered, 508.5 miles run while sounding, 3,964 positions determined (double angles), 24,986 soundings made, 4 tide stations established, 2 current stations occupied, 1 hydrographic sheet finished, scale 1:20,000.

The hydrographic resurvey of Pamlico Sound in progress at the beginning of the fiscal year was continued during July and August, 1916, and the sheet from Harbor Island Bar Lighthouse to Ocracoke was completed.

The general development consisted of systems of parallel lines spaced according to the depth. Special development was made of isolated shoals or where there seemed to be changes from the charted depths. All channels were carefully developed and particular attention was given to the channels in Ocracoke Inlet. These were developed out to the 6-fathom curve. Work had been begun on the sheet from Ocracoke to Hatteras when the transfer of the command was made.

The topography was continued along the outer island to a point about 3 miles south of Hatteras Inlet. All small islands adjacent to the outer coast were included on the sheet.

The triangulation was executed from time to time as the work progressed. Some difficulty was experienced owing to the unstable support for the instrument afforded by some of the lighthouse structures.

An automatic tide gauge was kept in operation at Portsmouth until the middle of July. Three permanent bench marks were established. Three tide staffs were determined by comparative readings and used in the hydrography. One old bench mark was recovered.

[R. F. LUCE, Commanding Schooner *Matchless*.]

**SUMMARY OF RESULTS.**—Triangulation: 19 square miles of area covered, 4 observing tripods and scaffolds built, heights, one 72 feet, two 55 feet, one 20 feet, 3 stations in main scheme occupied for horizontal measures, 1 station in supplemental scheme occupied for horizontal measures, 5 geographic positions determined. Leveling: 1.5 miles of levels run, 5 permanent bench marks established. Hydrography: 15 square miles of area covered, 91 miles run while sounding, 442 positions determined (double angles), 3,881 soundings made, 3 tide stations established, scale of hydrographic sheets 1:20,000.

After the transfer of the command of the schooner *Matchless* on June 3, the survey of Pamlico Sound was continued and this work was in progress at the close of the fiscal year.

The chief work of the party during June was the erection of tall signals for use in the hydrography. The instructions called for a considerable amount of hydrography to be done in the center of Pamlico Sound where shore objects were not visible, and it was necessary to build specially tall signals on the outer edge of the shoal water which extended out several miles from the shore.

The triangulation of this section had already been completed and two triangulation stations had been determined on the edge of shoal water, one at Bird Island and one at Gull Island. Bird Island could not be recovered, but a signal 55 feet high was erected near the former site of the station. Gull Island was recovered, and a signal 72 feet high was erected over it. A similar signal was erected on the outer edge of shoal water about  $2\frac{1}{2}$  miles west of the town of Kinna-keet. A tripod signal was erected over the former triangulation station on Kings Point and another in about 3 feet of water about 2 miles south of signal Water 2.

As stations Bird Island and Red Beacon could not be recovered, some additional triangulation was necessary to locate signals and other prominent objects for hydrographic purposes.

Hydrography was begun June 23 and continued to June 27. The work done was in the vicinity of Muddy Slough and in the channels and passages between Muddy Slough and the coast to the southward, the soundings being spaced closely enough to develop all channels and irregularities of bottom.

A tide staff was established on a wharf at the town of Hatteras and another on Fuersten's fish house, at the eastern end of Muddy Slough, and readings were taken while the hydrography was in progress. A subsidiary tide staff was established at the town of Buxton.

[F. B. T. SIEMS, Commanding Schooner *Matchless*.]

**SUMMARY OF RESULTS.**—Triangulation: 60 square miles of area covered, 46 signal poles erected, 2 observing tripods and scaffolds built, heights 30 and 35 feet, 11 stations in main scheme occupied for horizontal measures, 30 stations in supplemental schemes occupied for horizontal measures, 55 geographic positions determined. Leveling: 2.75 miles of levels run, 11 permanent bench marks established. Topography: 15.2 square miles of area surveyed, 130.8 miles of general coast line surveyed, 13 miles of roads surveyed, 3 topographic sheets finished, scales 1:10,000 and 1:40,000. Hydrography: 229.3 square miles of area sounded, 1,973.1 miles run while sounding, 9,349 positions determined (double angles), 84,211 soundings made, 5 tide stations established and recovered, 4 current stations occupied, 4 hydrographic sheets finished, scales 1:20,000 and 1:40,000.

The survey of Ocracoke Inlet was completed just prior to the transfer of the command of the schooner *Matchless* on August 24, 1916, and is referred to in another abstract.

The hydrography, supplemental triangulation, and the topography were afterwards taken up in the area by "the Banks" from Ocracoke Inlet to and including the town of Hatteras and for a distance of about  $9\frac{1}{2}$  miles offshore in Pamlico Sound, also including Hatteras Inlet. All of this work was completed by November 13, 1916. As the weather became unfavorable for the economic operation of the party, field work was closed and the *Matchless* proceeded to Elizabeth City, N. C., for annual repairs.

It was found that the light whaleboat launches are unsuitable for hydrography in the exposed parts of Pamlico Sound during moderately rough weather. On many days field work was prevented by moderate to strong northeasterly winds. It became at times impossible to get up high enough to observe on distant signals while the launch was violently tossed about.

Small boats were anchored and used for signals where shore signals were no longer visible.

The flat-bottomed skiff launch is well suited for most of the shallow inshore area. Where the depth was less than  $1\frac{1}{2}$  feet the area was sounded out by wading over the flats or by using small boats. No large areas were left unsounded.

Except for the areas inshore within about  $2\frac{1}{2}$  miles of the beach and those affected by the tidal currents of the ocean inlets, the bottom is mostly flat, uniform, and featureless as indicated in the old survey; in fact, practically the same depths and slightly undulated areas appear in both surveys. There are marked changes, however, inshore, and at Hatteras Inlet the bottom is much cut up and very complicated with numerous short deep sloughs many of which do not appear on the present chart. The main channel from seaward at Hatteras Inlet is now obstructed by a 7-foot bar at its entrance, where the old survey shows a clear straight passage of 14 feet from the sea to the sound side of the inlet. A narrow, crooked, and impracticable channel of probably 10 feet least depth was discovered to the eastward of the main channel. Three very complicated channels with 5 feet least depth were discovered leading over the bulkhead from the inlet to the sound. A very careful survey of this inlet was made which will be of value in studying the changes likely to occur in the

future by comparing it with the old survey. It appears that the ocean bar will in course of time close up the inlet.

Two scaffold hydrographic signals were built for offshore hydrography, one 70 feet high on Legged Lump and the other 40 feet high on Egg Shoal. The topography of "the banks" was a simple matter except that much time had to be spent in rodding the intricate marsh shore line on the sound side. Difficulties in getting ashore over the vast area of shallow water also hindered rapid progress of the plane-table party. There was good triangulation control for the topography. The only changes of importance in the shore line were found at the inlet, where several islets were found to have shifted considerably.

The triangulation included the determination of the positions of prominent objects, aids to navigation not previously determined, and several intersection points that will prove useful in future surveys. Enough old stations were recovered to obtain good determinations of the new positions.

Tides were observed at Nine Foot Shoal Beacon, at Hatteras, at Hatteras Inlet, and at Shoal Point Beacon.

Currents were observed at a point about halfway between Ocracoke and Hatteras Inlet,  $5\frac{1}{2}$  miles offshore, during 17 hours of good weather with very little wind.

The *Matchless* was anchored on the working grounds about 3 miles off Ocracoke from July to September and about 4 miles off Hatteras from the latter part of September to the middle of November.

On January 10, 1917, repairs to the schooner *Matchless* were completed, and on January 15 the ship sailed for the working ground in Albemarle Sound and tributaries.

Combined surveys were made of Perquimans River from January 16 to February 10, Little River from February 14 to March 16, and of Bull Bay and Scuppernong River from March 19 to April 13. On the latter date the command of the vessel was transferred to another officer who then took up the survey of the Yeopim River.

The surveys of the areas mentioned and those executed by the steamer *Hydrographer* in 1915 form a complete resurvey of these tributaries and the adjacent section of Albemarle Sound.

The topography included the location of the shore line and adjacent topographic features, the detail surveys of the towns of Hertford and Columbia, and the location of prominent objects. The shores are washing away in many places leaving the water full of cypress stumps.

Sounding lines were run normal to the shore 200 meters apart or less as required. These lines were crossed by lines parallel to the shore to determine the extent of spits and shoals. A careful survey of the entrance to Little River was made. The channel was found to be narrow but straight and the buoys marking the same sufficiently numerous and properly placed.

Some difficulty was experienced in carrying the triangulation from the main scheme in Albemarle Sound to Little River on account of the washing away of some stations and the poor seeing across the sound. Two tripod and tree signals were built for this work.

Numerous stations were required to extend the triangulation schemes up the tributaries. The stations were carefully marked and referenced, having in view the rapid washing away of these shores.

# GEORGIA.

[PAUL C. WHITNEY, Commanding Steamer *Bache*.]

**SUMMARY OF RESULTS.**—Triangulation: 3 hydrographic signals rebuilt, height 100 feet. Magnetic work: Ship completely swung at 2 sea stations. Hydrography: 2,050 square miles of area covered, 1,401 miles run while sounding, 2,315 positions determined (double angles), 18,330 soundings made, 1 tide station established, 448 specimens of bottom taken, 2 hydrographic sheets finished, scales 1:80,000 and 1:180,000. Physical hydrography: 108 current stations occupied, 409 observations of temperature of water taken.

After being repaired at Norfolk, Va., the steamer *Bache* left there January 17, 1917, for Savannah, Ga., arriving January 20. The latter part of January was spent in hydrographic work. On January 29 the *Bache* left Savannah for Charleston, S. C., where the buoys to be used for offshore signals had been delivered.

The necessary superstructures were constructed on the buoys and the buoys were placed in position about 10 miles from shore and 4 miles apart by lighthouse tenders.

On returning to the working grounds it was discovered that three of the tall signals on shore had been damaged by storms, and arrangements were made to rebuild them.

The hydrography completed covers the area between Ossabaw Sound and Port Royal Sound. Its southern limit overlaps the work done by the *Bache* during the spring of 1916. Its northern limit overlaps the work done by the steamer *Isis* during 1916.

On the inshore work, to obtain the necessary development near the entrance to Savannah River and the sounds close by, lines were run at a distance of about one-third of a mile apart. Near the bar at the entrance to Savannah River, on shoals and in places where the soundings were uneven, lines were run considerably closer together. In the offshore work from the line of buoys east to the 100-fathom curve, lines were run 1 mile apart well beyond the 12-fathom curve, 2 miles apart to the edge of the inshore sheet, and approximately 4 miles apart to the 100-fathom curve. Every precaution was taken to determine accurately the positions of these lines.

Current observations were made every two hours on the dead-reckoning lines. Surface temperatures were observed every hour while sounding to 30 fathoms and at every sounding from 30 to 100 fathoms. Bottom temperatures were taken at every anchorage and at every sounding outside the 30-fathom curve. Psychrometer readings were taken every hour while sounding. Tides were obtained from the automatic gauge of the United States Army Engineers located on Tybee Knoll.

On the night of March 22 assistance was rendered the steamer *Kelvinbrae* by rescuing from drowning one of the crew of that vessel who had fallen overboard.

## GEORGIA AND FLORIDA.

[T. J. MAHER.]

**SUMMARY OF RESULTS.**—Triangulation: 4 hydrographic signals built, heights, 94, 94, 92, and 104 feet, 3 triangulation stations recovered, marked, and described, 4 triangulation stations (other than the foregoing), recovered and supplementary descriptions made, 1 new triangulation station established, 4 triangulation stations, other than the foregoing, selected and signals built, 3 triangulation stations occupied for horizontal measures, 3 old signals examined, 2 hydrographic signals occupied for round of angles.

On October 17 orders were issued for the organization of a party to build tall hydrographic signals along the coasts of Georgia and Florida for the use of the parties on the steamers *Bache* and *Isis* respectively.

After consultation with the commanding officers of the two vessels as to the work required, a party was organized at Savannah, Ga., and on November 4 left Savannah for Hilton Head Island, S. C. Station Hilton near the north end of the island was recovered, but the signal which had been erected there during a former season had blown down. The beach in that locality had washed away to such an extent that anchors for the wire guys on the shore side could not be placed. A new signal was erected eccentric to the old in a more suitable locality and located by angles and a measured distance. The height of the signal is 96 feet, and it has a target 50 by 16 feet in dimension, the upper half painted black and the lower half white. The party then proceeded to the south end of the island where a similar signal was erected. This station was located from three triangulation stations along the Savannah River. The shifting of the sand dunes had obliterated all traces of station Braddock which had been established in that vicinity in 1900. The signal near the lighthouse was visited and examined. The signals along the shore north of Port Royal Sound were seen to be standing, but owing to the shallow water could not be reached by the launch or by small boat.

During December the party was engaged in building a signal on the south end of Little Tybee Island and one on the south end of Wassaw Island. The former is 96 and the latter 104 feet in height, not including the elevation of the ground above high water. Two triangulation stations on Little Tybee Island were recovered. One was re-marked with surface and subsurface marks, and additional reference marks were made for the other. Descriptions were prepared for both stations.

A tree marked with a triangular blaze on the side with a nail in the center and branches cut near the top was found near the signal on Wassaw Island. It was close to the edge of a bluff which was rapidly washing away. A surface and a subsurface mark were placed eccentric to the tree and a connection made by measurement and angles. A signal was erected over the stump of the tree and located by triangulation. The dune on which the signal Drop (1913) was located has been washed away. Triangulation station Morrell, Ossabaw Island, was recovered, connected with reference marks, and a description prepared. The signal was rebuilt. Station Land was recovered and a triangulation signal built. Station Coon was estab-

lished on Raccoon Key. These were occupied for horizontal angles. Hydrographic signal camp was examined and some guys tightened. Signal Meadows was similarly examined. A search was made for station North, but it was not found, as the dune on which it was situated had been washed away. This was verified by a stadia traverse from signal Meadows.

On December 23 work in Georgia waters was nearly completed. Information was received that the signal on Little Tybee Island had fallen during a storm. The remainder of the month was spent in rebuilding this signal, and the work was completed on January 2. The signal at Wassaw Island was examined and additional guys were attached. The signal at Hilton Head which had blown down was rebuilt.

The triangulation in the vicinity of the mouth of the Savannah River was completed. The old Coast and Geodetic Survey station on Fort Pulaski was recovered and the marks renewed.

A signal was built 5 miles south of Pablo Beach and its position determined by a traverse and tape measurement from the old station. Work was closed on February 4.

#### FLORIDA.

[G. T. RUDE, Commanding Steamer *Isis*.]

**SUMMARY OF RESULTS.**—Hydrography: 2,650 square miles of area covered, 2,368 miles run while sounding, 4,794 positions determined (double angles), 23,227 soundings made, 35 stations occupied by ship to locate shore and offshore signals, 210 angles observed (sextant cuts) by ship to locate shore and offshore signals, 8 shore objects located by angles from ship, 11 offshore buoys (signals) located by angles from ship, 2 hydrographic sheets finished, scales 1:60,000 and 1:180,000. Physical hydrography: 1,072 surface temperatures taken, 571 bottom specimens taken, 4 log tests made, 111 current stations occupied, 803 current observations taken.

The steamer *Isis* was undergoing alterations and repairs at Norfolk, Va., from July 1 to December 20, 1916, when she came to Washington to have a radio apparatus installed.

From January 6 to April 30 the vessel was employed on offshore hydrography on the east coast of Florida from the St. Johns River entrance to a point  $5\frac{1}{2}$  miles south of St. Augustine and extending offshore to the Gulf Stream. This work covers an area of 2,650 square miles and consists of 2,368 miles of sounding lines.

The vessel was laid up at Norfolk from May 2 to June 30 because of shortage of funds, during which time some minor repairs were made and the records of the past season's work were completed. The vessel made its headquarters at Jacksonville, Fla., during the entire season.

Very satisfactory signals were erected and located by J. S. Bilby along the entire coast line from the St. Johns River to a point  $8\frac{1}{2}$  miles south of St. Augustine. They were of two kinds, the tall type, about 100 feet high, and intermediate signals, about 20 feet high, for the close inshore work. It has been found that the tall signals should not be spaced along the coast more than  $3\frac{1}{2}$  to 4 miles apart for the most economical prosecution of the work. Those built by Mr. Bilby were about that distance apart.



The following are tall signals: Pablo, Mier 2, Palm, Jenks 2, Hernan, Dry, Cato, Louis, Crescent, and Corbett. Mt. Cornelia and March are high-type signals built during the previous seasons and used by the *Isis* the past season. They were in excellent condition. The following are small signals built by Mr. Bilby for close inshore hydrography: Z(Lit), Y(Bil), Axe, Way, Vat, Usina and Uno. In addition to these signals artificial objects, previously located by triangulation were used. Other signals were located by sextant cuts from the *Isis* anchored offshore.

Four tall-type can buoys and two whistle buoys, with angle-iron and pipe superstructures, carrying wire-screen target above and three black flags 6 feet long below, were used for offshore signals.

These types of offshore signals are without question the most efficient and durable and have the longest range of visibility of any signals yet devised for this class of work. The body of the buoy is painted white and is the only part which shows when the vessel is between the sun and buoy; the superstructure showing when buoy is between vessel and sun. Any buoy without this reflecting surface is practically worthless for offshore hydrography, for at least one of the buoys of the set of three is on the opposite side of the vessel from the sun on every fix.

These buoys were loaned from the sixth lighthouse district, planted and shifted by the lighthouse tender *Cypress*. Thanks are due to the lighthouse inspector for the promptness with which these buoys were planted and moved and the courtesy shown the party in every possible manner.

These buoys were located as heretofore by means of sextant cuts to shore stations from the *Isis*, located inshore of the line of buoys.

It has been found that these buoys should be planted from 10 to 11 miles offshore and from  $3\frac{1}{2}$  to 4 miles apart for the most economical prosecution of the work.

The hydrography off the east coast of Florida consisted of two classes, the ordinary inshore or fixed position work and offshore or precise dead reckoning work.

An anemometer was installed on the *Isis* for use during the past season in obtaining the wind velocity for estimating leeway.

It was found that the amount of leeway estimated for the vessel during the season off the South Carolina coast, 0.1 knot per hour leeway for 10-mile wind, 0.15 for 15-mile wind, etc., was insufficient. During the past season it was found that each course should be corrected for leeway by an amount equal to 0.15 knot per hour for a 10-mile wind, etc.; in other words, 0.015 knot per hour times the velocity of the wind in miles per hour, reduced to the sine of the angle between the wind's direction and the course. This was generally obtained graphically by plotting the course at any place, and then plotting the correct leeway at right angles to the course at the end of the leg. The mean velocity and direction of the wind at the two anchorages were used unless the wind made a decided and noticeable change in direction and force during the time between anchorages. In that case they were employed separately in deducing the amount of leeway.

A diagram was devised from which may be obtained graphically the amount of drift of the vessel while weighing the current anchor at a station in the Gulf Stream.

The *Isis* anchored a barrel buoy at the 40-fathom curve with a 300-pound concrete block and 120 fathoms of  $\frac{1}{4}$ -inch Seimens-Martin strand wire; at the 100-fathom curve with a 400-pound block and 300 fathoms of wire. When the current observation had been made from a small boat, the barrel was taken on board and the wire run through the snatch block on the anchor davit to the floating barrel of the anchor windlass and wound in as fast as the windlass would take it.

From current observations made on the vessel while anchor was being weighed, in a current of known velocity, it has been found that the drift of the vessel was considerably retarded within the full drift of the current by the anchor which held her somewhat while she had the full lead of 300 fathoms, the retardation decreasing gradually as the scope of the wire decreased.

At anchorages in the Gulf Stream the drift of the vessel was accurately determined by means of a diagram by the following plan: A base (101.3 feet), equal to 2 knots on a 30-second current line, was measured along the rail of the *Isis* (if the vessel, on account of wind, does not lie with the current, the better plan is to use a current pole and current line, allow the line to run out for 2 knots, and note the time, instead of using the base on the rail). As soon as a strain was put on the anchor wire, a chip was thrown over the side forward and the time required for it to pass along this base recorded. In three minutes' time this was repeated, and the mean of the times was taken for that three minutes. This was done every three minutes till anchor was off bottom.

It will be noted that, if the vessel be in a 3-knot current and the anchor holds her so that the current past the vessel is at the rate of 2 knots per hour, she drifts only at the rate of 1 knot. From this the actual drift was computed for a 1, 2, 3, 4, and 5 knot current, decreased by the amount the anchor held the ship as shown by the mean length of time required for the line to run out 2 knots, and a current curve and diagram were made, from which the actual drift may be scaled for these and intermediate currents.

Another diagram was devised from which may be read directly the correction to be applied to an observed current for the swing of the vessel during the time the observation is being made. Two sheets are necessary, one in which the stern of the vessel swings toward the current pole after the observation is begun and the other away from the current pole.

In order to lessen the chances of losing the survey buoys if sunk from being run down by passing steamers, reference barrel buoys were anchored, with Seimens-Martin, one-eighth inch, strand wire and 300-pound concrete block, an estimated distance away from and on an observed bearing from the survey buoy in order that the buoy might be recovered by grappling hooks.

Later during the season it was found that a 5-gallon tin kerosene can anchored with about a 30-pound concrete block and cotton cod line answered the purpose much better, in addition to being a much cheaper method.

A marked improvement was made to a navigating sextant for use on offshore hydrography by the substitution of a large telescope for the one supplied with the instrument. This change was made by the instrument section, using one-half of a pair of binoculars. It is con-

servatively estimated that one-third more time was actually spent on sounding work than would have been possible without this instrument. In the afternoon when shore signals became indistinct on account of haze this sextant was used for the least distinct signal and the line continued, whereas with the ordinary sextants the line would have ended and the vessel anchored. This was the case nearly every afternoon during the months of February, March, and a part of April.

C. K. Green, deck officer, devised an electric attachment for a sounding clock, which was used with excellent results during the past season.

Four tests were made during the season over a 2-mile course for standardizing the logs. It is thought that these tests should be made at least once a month in order to have an accurate rate. The rate changes considerably and probably from several different causes, the striking of the rotator against the side of vessel when hauling in, lag due to oil hardening in the working parts, etc.

More elaborate log tests were made for the different speeds. It was found that each log had different rates for slow speed, full speed, running full speed for  $1\frac{1}{2}$  minutes and drifting for  $1\frac{1}{2}$  minutes for sounding in depths over 15 fathoms with trolley rig, and yet another rate for running full speed for 2 to  $2\frac{1}{2}$  minutes and backing to full stop for upright cast with wire and registering sheave. The vessel was run over the measured base several times and the rate obtained for each speed, the different round trips checking very closely.

A large number of bottom specimens were obtained and recorded and a quantity of the best specimens saved. It was impossible to obtain bottom samples in the hard sand and shell bottom along the east Florida coast with the Stellwagen specimen cup. This cup is too blunt and also too large. The greater part of the specimens obtained this past season was by the use of soap in the end of the lead.

A cup, similar to the Stellwagen cup except that it is sharper and has a shorter cone, was devised on the *Isis*. This cup was not completed in time for use during the past season, but it is thought that with it bottom specimens may be obtained in hard sand or shell bottom.

The electric sounding machine installed on the *Isis* at the beginning of this season is entirely satisfactory. It has been used during the whole of the past season with lead line and trolley rig on all in-shore dead-reckoning work and on the inner ends of lines to the Gulf Stream, and with wire and registering sheave on the outer ends of these lines.

Before using it for the lead line and trolley it was necessary to install several new kinds of springs to keep the lead line from jumping the drum. The single one on the machine intended for wire would not answer for the lead line.

The controller and brake are excellent, allowing perfect control of the drum at all speeds, in fact much better control than over the hand machine at slow speed.

Considerable information for the accurate running and plotting of the offshore dead-reckoning lines was obtained as to the velocity of the current in the edge of the Gulf Stream by a series of anchorages in the stream instead of only the one at the 100-fathom curve as previously made on this work. On all but the last line it was

found that the strength of the current was from 0.6 to 0.8 knot at the 25-fathom anchorage, about 2 knots at the 40-fathom anchorage, and about  $3\frac{1}{2}$  knots at the 100-fathom anchorage, the direction in each case coinciding with the trend of the 100-fathom curve.

At all anchorages at and inside the 25-fathom curve the steamer was anchored with her regular ground tackle; at the 100-fathom curve by the same apparatus, devised and used on this vessel last season off the coast of South Carolina, except that Seimens-Martin, one-eighth inch, strand wire was used instead of ordinary strand wire. The drift was obtained by means of an ordinary current pole and the set with pelorus referred to the quarter-deck compass. At each station two observations through two minutes each were made and the resulting current divided by four. Much better results were obtained by this method than by observing three sets for 30 seconds each.

The drift of the current varied from 0.2 to 0.3 knot during small tides and light winds to as high as a knot during large tides and strong winds.

The set, as the tide ebbed and flowed, formed an ellipse, the axis of which was about west-northwest and east-southeast. Wind produces a marked effect upon this ellipse, lengthening from the origin in a direction with the wind and shortening toward the wind. During a heavy wind the whole ellipse is forced to the leeward of the origin and the direction of the currents apparently moves counter clockwise while as a matter of fact they are working clockwise but outside the origin.

During the season while at anchor when conditions were unfavorable for sounding, current observations were taken from the *Isis* every hour day and night.

Tidal observations for the reduction of soundings were obtained through the office from the automatic tide gauge at St. Augustine.

In order to obtain a relation between the tides outside and those at the St. Augustine gauge, the results from the Army Engineer staff erected at Atlantic Beach may be utilized.

Upon arrival at Jacksonville the tall hydrographic signals along the coast had not been erected, so the time necessary for the signal-building party to get ahead by a few signals was spent on log test, ship swings, and compass compensations.

Owing to the *Isis* having been moored, heading in one direction for six months, and also on account of new construction, the deviation had increased from  $3^{\circ}$  to  $11^{\circ}$ . The compasses were compensated and this deviation again reduced to  $3^{\circ}$ .

While engaged on lines to the 100-fathom curve, observations were made at fixed intervals with whirling psychrometer and also surface and bottom temperatures were obtained. In addition to these, barometer, air, and surface temperatures were recorded in the ship's log by the quartermaster on watch every hour during the season.

The ship was swung for deviation four times during the period January 30 to April 27. The deviation changed very little between swings.

Observations were made at intervals with the dip measure when the sea was smooth, rendering these observations possible. When the sea was rough and the vessel rolling, reliable observations with this

instrument were impossible. The three axes, fore and aft, horizontal, and vertical, can not be held in position a sufficient length of time for a good contact when the vessel rolls. It is thought, though, that with a rough sea refraction is very near normal and tabulated sufficiently close for a sight at sea.

On February 18 a fire occurred on the water front in south Jacksonville at a lumberyard and shipbuilding plant. Before the fire was under control the launch of the *Isis* was sent over and towed the yacht *Soncy* to a safe berth.

On April 28, when bound up the St. Johns River for Jacksonville, the *Isis* passed the steam schooner *Rosalie Mahoney* afire and beached on the east side of the river half way between beacon 19C and Chaseville. The *Isis* went alongside, made fast to her on the windward side and for three hours used the fire hose and crew to assist the tugs *Smith* and *Volunteer* in getting the fire under control. The *Mahoney* was loading creosoted piles for Cuba. The cargo was ruined and the vessel gutted by fire, only the hull being saved.

[J. H. LAWLEY.]

**SUMMARY OF RESULTS.**—Hydrography: (wire drag) 92 square miles of area dragged, 130.4 miles run while dragging, 558 positions determined (double angles), 10 soundings made (on shoals), 1 tide station established, 212 soundings made (to supplement charts), 1 hydrographic sheet partly finished, scale 1:40,000.

In accordance with instructions issued March 6, 1917, a party was organized for wire-drag work in the western part of the Florida Reefs.

The officers of the party arrived at Key West on the morning of April 23.

Three launches were hired for the use of the party. Although seaworthy these launches were not well adapted to the use of the wire-drag party owing to shallow draft, low power, and lack of accommodations for the party.

From April 23 to May 9 the party was at Key West preparing the outfit, installing equipment on the launches, obtaining supplies, etc. Two whistle buoys and two first class standard cans were furnished by the lighthouse inspector, and superstructures similar to those used by the steamer *Isis* were fitted to these buoys.

After a delay of one day caused by bad weather the party left Key West on May 10 with the three launches and supplies for one month, arriving at Dry Tortugas on the afternoon of the same day. The lighthouse tender *Ivy* preceded the party on May 9, carrying most of the heavy supplies, and placed the four signal buoys in position on the working grounds on May 10.

At Dry Tortugas the party found a good harbor and an abundant water supply. It was necessary for the officers and hands to provide all camp furnishing and cooking equipment.

From May 11 to May 13 the party was engaged in building and locating signals and establishing quarters at Dry Tortugas.

Dragging was started on May 14 but fresh north to east winds with thick haze prevailed until May 21 so that little could be accomplished before that date. From May 21 until May 30 the weather was generally favorable but from May 31 to June 10 fresh winds

shifting from northeast at night to southeast during the day created heavy cross seas which, complicated by strong currents, made drag work impossible in open waters.

Work was resumed on June 11 and continued under fairly favorable weather conditions until the end of the month, although fresh east winds and heavy squalls interfered with its progress toward the end of the month.

At the end of June, work was being done in Rebecca Shoal Channel whenever the weather permitted, and at other times to the southward and eastward to Dry Tortugas with the idea of gradually extending this work to join with that in the channel.

The four signal buoys were placed on a line extending southwest by south from Rebecca Shoal Lighthouse and spaced about 2.5 nautical miles apart, being located by theodolite angles from Loggerhead and Rebecca Shoal Lighthouses. These signals are found to be very satisfactory and are readily observed from distances up to 6 miles.

Numerous supplemental soundings were obtained by the large tender along the dragged lines in order to fill in the open spaces on the present charts.

No shoals especially dangerous to navigation were discovered.

In order to drag all areas within the field of work, additional floating signals are needed, and it is believed that a satisfactory type has been devised and constructed, although it has not yet been tried out in actual work.

This signal consists of a heavy center pole 25 feet long with a target at one end and a counterweight at the other. It is supported at a point about 15 feet from the top by three barrels, securely lashed and braced, and the mooring line is attached at the water line. A signal constructed in this manner stands vertical in quite heavy weather, shows up well at a distance of 5 nautical miles, and can be easily handled by our launches.

A tide staff was erected at Dry Tortugas and connected with one bench mark established in 1901. Two additional bench marks were established.

The party is indebted to the lighthouse inspector at Key West for his hearty cooperation in transporting supplies and for assistance in fitting out the floating signals; also to the officer in charge of the marine laboratory of the Carnegie Institute at Loggerhead Key for the numerous courtesies extended by him.

[L. A. POTTER.]

On July 1 the revision of the Inside Route Pilot from New York to Key West had been completed from Norfolk, Va., southward to St. Augustine, Fla.

The section of the waterway from St. Augustine to Key West was covered between July 1 and 13, in a chartered launch, stops being made at all of the towns en route.

On July 14 the return trip to Washington was begun, stops being made at the principal cities to interview United States Engineer Officers, Lighthouse Service officials, and others concerning doubtful points brought out by the field work.

The officer in charge of this work arrived at the Washington office July 24 and began the office compilation of the Inside Route Pilot.

## LOUISIANA AND MISSISSIPPI.

[H. A. SERAN, Commanding Steamer *Hydrographer*.]

**SUMMARY OF RESULTS.**—Triangulation: 120 miles of area surveyed, 3 signal poles erected, 5 observing scaffolds and tripods built, heights 80 to 90 feet, 3 stations in main scheme occupied for horizontal measures, 1 station in supplemental scheme occupied for horizontal measures, 8 geographic positions determined. Leveling: 10 miles of levels run, 11 permanent bench marks established. Magnetic work: ship swung at 4 sea stations. Topography: 274.5 miles of general coast line surveyed, 30 miles of shore line of rivers surveyed, 4 topographic sheets finished, scale 1:40,000. Hydrography: 721 miles of area covered, 2,498 miles run while sounding, 9,889 positions determined (double angles), 77,098 soundings made, 7 tide stations established, 5 current stations occupied, 3 hydrographic sheets finished, scale 1:40,000.

The survey of the eastern approaches to the Delta of the Mississippi River was begun by the party on the steamer *Hydrographer* in July, 1916.

The instructions for this work called for a resurvey of the eastern approaches to the Delta with the principal object of obtaining the present edge of the Delta and the outside shore line.

Actual survey work was begun on July 28 and closed on account of bad weather October 21.

The hydrography between the edge of the Delta and the 20-fathom curve was done with the hand lead. Beyond the 20-fathom curve pressure tubes were used. It was found by experiment that the Tanner-Blish tubes were more accurate than the Bassnet sounders, especially in depths over 50 fathoms. Sufficient soundings were made with the lead to keep a close check on the depths recorded by the Tanner-Blish tubes.

For the offshore hydrography tall hydrographic signals were necessary. Four of these signals from 80 to 90 feet in height and several smaller scaffolds were built.

The currents in this region are so variable that any discussion of them will have to follow an extended series of observations. Without any disturbing westerly wind, the natural trend of the currents is to the westward.

Weather conditions became very unfavorable in October and culminated in a tropical hurricane on October 17 and 18. This hurricane absolutely destroyed the tall hydrographic signals and rendered necessary their rebuilding before any additional work could be done. Work in the Delta was accordingly closed for the season.

The topography of the Delta was extended from the western limits of the sheet to a point about 5 miles west of Pass a Loutre Lighthouse.

The triangulation consisted of the necessary observations to locate the signals for control of the hydrography and topography. The tidal information was obtained from the gauge maintained in East Bay by the Mississippi River Commission.

This survey, even in its incomplete state, shows that this region needs to be frequently resurveyed. The edge of the Delta as marked by the 3-fathom curve has been extended seaward about 1 mile off Garden Island Bay and about 2 miles or more off the mouth of Pass a Loutre. Other changes noted include the closing of various small passes between South Pass and Pass a Loutre, the washing away of the mud lumps in places, and their appearance in others.

Investigations carried on by the United States Army Engineers and the Mississippi River Commission show that the whole area is subsiding. Permanent precise bench marks are impossible within miles of the mouth of the river. The results of the tidal observations at the East Bay gauge, which was used for the present survey, show that during the past few years the subsidence has been relatively the same between the gauge and the bench marks. The lines of levels, which are frequently run along the passes of the river, show that the whole country is sinking at a more or less uniform rate.

On October 30, after the weather had made further work at the mouth of the river unprofitable, instructions were issued directing that a "comprehensive resurvey of Mississippi Sound and tributaries, the islands on the south side, and the entrances from the Gulf between Mobile Bay and Lake Pontchartrain" be made. These instructions provided that in addition to working from the vessels, shore parties were to be established with additional officers and men at such places as were necessary for the successful prosecution of the work. Work under these instructions was begun on November 9 and continued until May 24, when the shore party had to be disbanded on account of a shortage of funds. From the period May 7 until May 24 the vessel was absent from the Mississippi Sound working grounds doing some work at the mouth of the river, in accordance with instructions as mentioned in the following paragraph.

On April 19 instructions were issued directing that certain check soundings be made at points indicated to further check the tube sounding that had been done at the mouth of the river and that certain check lines of soundings be run between the 15 and 20 fathom curves. Supplemental to these instructions, others were received that directed the inshore work to be done out to the 30-fathom curve from the entrance to South Pass westward to meridian  $89^{\circ} 15'$ . Work under these instructions was done from May 7 to June 21. On the latter date the work had been completed, and the vessel proceeded to New Orleans and was laid up until the end of the fiscal year.

At the mouth of the Mississippi River the hydrography was extended from a few miles north of Pass a Loutre westward to meridian  $89^{\circ} 15'$ . The inshore limit of this work is in general the 3-fathom curve and the outer limit varies from 20 fathoms at the northern end of the work to 30 fathoms west of South Pass. In the area immediately southeast of the mouth of South Pass, the hydrography was carried out to the 100-fathom curve. Prior to October 21, a large part of the work between the 50 and the 100 fathom curve was done with pressure tubes, the Tanner-Blish tubes being used. The soundings in this area taken in May and June, 1917, are all up-and-down casts made while the ship was stopped and working the engines if necessary to secure them. In general the agreement between the soundings as recorded previously by the pressure tubes and the vertical casts made for checking purposes was excellent. Where any marked difference was found additional soundings were made.

The sounding done between the 15 and the 20 fathom curve was done with the double sounding-chair arrangement mentioned previously. Off the mouth of Pass a Loutre, the depths had changed so that additional lines were run until a satisfactory junction had been made. The Mississippi River had passed through a high-water



period since the survey of last year, and an immense amount of sediment had been deposited at the various mouths of the river.

Reports of a shoal off the mouth of South Pass have been made at various times in the past and instructions were given to run several lines of soundings over the area that had been reported foul. These lines were run, and in the area covered the soundings were regular and increased to the southward as might be expected.

It was found that the tall hydrographic signal near the mouth of Southeast Pass could not be carried as far seaward by day as was desired and the work was done at night. Two acetylene signal lights were mounted on the top of the signal. The angle between the two pointings was about  $24^{\circ}$ , the limits of visibility of the two lights about embracing the limits of the area to be covered. One of the observers was swung in a boatswain's chair at the yard arm, and by this means it was possible to secure one angle and a bearing giving a better location than the dead reckoning to such a distance.

In Lake Pontchartrain and Mississippi Sound the hydrography was extended from meridian  $89^{\circ} 52'$  to the western entrance of the Rigolets, and from Shell Point and the eastern entrance to the Rigolets to about half way between Gulfport and Biloxi. In Lake Borgne, a line from Shell Point to Grand Island marks the southern limit of the closely developed work. South of this line several reconnoissance lines were run with the ship. The soundings obtained on these lines showed little change from the soundings shown on the present chart, and the work was extended no farther south. In Mississippi Sound, a line from Grand Island to Isle au Pitre and from Isle au Pitre to the western end of Ship Island marks the southern limit of the closely developed work. Between Grand Island and Isle au Pitre a few reconnoissance lines were run with the ship with the same result as found in the reconnoissance lines in Lake Borgne. A few miles of soundings were run at the western end of Horn Island.

The hydrography in Lake Pontchartrain was done with the launch from the ship. The results of this work showed that the so-called middle ground between the New Orleans & Northeastern Railroad drawbridge and the Rigolets was much smaller than is shown on the present charts and also that the shoal water at the Lake Pontchartrain entrance to Chef Menteur is much more limited than is shown on the present charts.

The launch hydrography of Lake Borgne and of Mississippi Sound from Lake Borgne Lighthouse to Cat Island and the small amount of hydrography at the western end of Horn Island were done by a shore party.

The launch hydrography of Mississippi Sound from Cat Island to the eastern limits of the work was done by a shore party while the vessel was at Mobile for repairs.

The topography in Lake Pontchartrain was extended from a few miles west of West End on the south shore of Lake Pontchartrain eastward to the western entrance to the Rigolets and from the Rigolets to Big Point along the north shore of the lake. In Lake Borgne, the topography was extended from Shell Point to Lake Borgne Lighthouse including Grand Island. In Mississippi Sound the topography was extended from Lake Borgne Lighthouse to Bellefontaine Point, about 10 miles east of Biloxi, Miss. Isle au Pitre, Cat Island,

and the shore line of St. Louis Bay were also surveyed. A couple of days' work at the west end of Horn Island was also done.

All the topography was a revision. Especial attention was paid to features that would be of value in navigation and to securing the names of all points, bayous, creeks, etc. Few great changes in the shore line were found. This is rather remarkable when the destructive effect of the storms to which this section is subject are considered.

The instructions of October 30 called for a connection of the triangulation of Lake Borgne with the triangulation of Lake Pontchartrain. This connection was made at the eastern end of Lake Pontchartrain. The old stations Biloxi Bayou, Malheureaux Point 2, and Old Tower, of the Lake Borgne scheme, were connected with the stations Point aux Herbes Lighthouse, North Draw, and West Rigolets Lighthouse, of the Lake Pontchartrain triangulation.

In addition to this connection it was necessary to do some supplemental work for stations for control of the topography and hydrography. The storm of September, 1915, had destroyed all the beacons, etc., previously located in Lake Borgne and Mississippi Sound, and new locations had to be made of them. Some stations were also located along the north shore of Mississippi Sound to be used as hydrographic signals. The Gulfport Channel beacons were relocated.

All the triangulation was tertiary in character. The new stations were marked and described.

For the hydrography of the Mississippi River Delta approaches, the tidal data were obtained from the Mississippi River Commission, which has maintained an automatic tide gauge in East Bay across the river from Port Eads for a number of years. This gauge is connected with the gauge also maintained by them at Biloxi from which the mean gulf level has been determined by precise levels.

The tidal data for the hydrography of Lake Pontchartrain were obtained from tide staffs placed at West Rigolets Lighthouse and at the north draw on the New Orleans & Northeastern Railroad bridge across Lake Pontchartrain. Each of these staffs was connected with the staff at St. Louis Bay by simultaneous observations. The customary bench marks were established in the vicinity of West Rigolets Lighthouse and the tide staff connected with them. The original instructions called for a tide staff at West End to be connected with the staff at Bay St. Louis by simultaneous observations. This staff was placed, the observations made, and the staff connected with the bench mark, Halfway House, which is connected with the precise level net between Mobile and New Orleans. Three new bench marks were also established at West End and this staff connected with them.

The tidal data for the hydrography of Lake Borgne and Mississippi Sound were obtained from the automatic tide gauge installed at the draw on the bridge crossing St. Louis Bay. This gauge was established the early part of December, 1916, and is still in operation. The staff at this station is connected with one of the bench marks in the net between Mobile and New Orleans and with three new bench marks which were established at the Bay St. Louis end of the bridge.

When the shore party moved from Bay St. Louis to Pascagoula, Miss., a tide staff was erected at the latter place and connected with the staff at Bay St. Louis by simultaneous observations. The Pascagoula staff was also connected with one of the bench marks in the

net between Mobile and New Orleans. Three additional bench marks were established at Pascagoula and the staff was connected with them.

A staff was erected at Cat Island Lighthouse and connected with the one at St. Louis Bay by simultaneous observations. Tide observations were made by the lighthouse keeper when the party was working in the immediate vicinity of the lighthouse.

Currents, using the regulation current pole and line, were observed at four stations. The series at the western entrance of the Rigolets extended over a period of about 30 days. At the other three stations currents were observed whenever the ship was anchored in the vicinity.

The ship was swung for deviation at four stations, once off the mouth of Southeast Pass, Mississippi River Delta, in August, 1916, and again in the same vicinity in June, 1917, once about halfway between Shell Point and Malheureux Point in Lake Borgne and once just west of the dredged channel into Gulfport Harbor.

A shore party, living in camp, was established at the mouth of the Pearl River on December 7. The hydrography and topography of Lake Borgne were done from this camp. This party was moved in February to Bay St. Louis, which was used as headquarters for the survey of the western end of Mississippi Sound east to Cat Island. It was then moved to Pascagoula, Miss., April 23, and remained there. A fire destroyed the camp on May 2, and the party was disbanded on May 24.

A shore party was stationed in New Orleans from March 26 to April 11. During this time the topography of the south shore of Lake Pontchartrain from Point aux Herbes Lighthouse to a few miles west of West End was run, the tide staff at West End was erected, and the tidal observations made.

As the *Hydrographer* was to be laid up for repairs for a period of six weeks or two months, practically the entire crew was put in a shore party at Gulfport, Miss., to work in the vicinity of Gulfport while the vessel was being repaired. They were engaged on this work from February 16 until April 11.

An officer was sent to Port Eads in advance of the vessel on April 27 to rebuild the tall hydrographic signal for use in the offshore hydrography of the Mississippi River Delta. Signal Mud was rebuilt, and a small water signal built about halfway between signal Mud and South Pass Lighthouse. This party was working from April 30 until May 12.

#### TEXAS.

[J. B. BOUTELLE.]

The inspector at Galveston was principally occupied from July 1 to 22 in installing and attending to the Coast and Geodetic Survey exhibit at the Galveston Cotton Carnival.

On September 16 the location of the Coast and Geodetic Survey suboffice was changed from No. 19, Cotton Exchange, to No. 413, Security Building, Galveston, where it is now.

Information was collected for use in the correction of the charts, coast pilots, and tide tables, and a stock of the nautical publications of the Survey was kept on hand for consultation and sale.

Information in regard to publications, surveys, dangers to navigation, tides, etc., was furnished to persons applying for the same.

Sixty-four certificates of efficiency were issued to lifeboat men during the year.

The duties of the inspector include the collection of information for the correction of the charts, coast pilots, and tide tables; furnishing information in regard to surveys, tides, and dangers to navigation in reply to official and private requests; and the distribution and sale of charts and nautical publications of the Survey. The inspector was absent on field duty from April 3 to 17.

## HYDROGRAPHIC AND TOPOGRAPHIC WORK, PACIFIC COAST.

### CALIFORNIA.

[E. B. LATHAM.]

**SUMMARY OF RESULTS.**—Triangulation: 10 square miles of area covered, 1 signal pole erected, 3 stations in main scheme occupied for horizontal measures, 23 geographic positions determined. Leveling: 12 permanent bench marks (tidal) established. Topography: 18 square miles of area surveyed, 38 miles of general coast line surveyed, 12 miles of shore line rivers surveyed, 70 miles of roads surveyed, 3 topographic sheets finished, scales 1:2,500 and 1:10,000. Hydrography: 234.25 miles run while sounding, 1,928 positions determined (double angles), 10,633 soundings made, 4 tide stations established, 8 hydrographic sheets finished, scales 1:2,500 and 1:10,000.

In the early part of July the computations of the triangulation in the vicinity of San Diego and elsewhere on the coast of California undertaken at the request of the Bureau of Lighthouses, were completed.

On July 9 the observer left San Diego for Cayucas and Morro, Cal., to supplement the hydrography off the port of Cayucas and make certain investigations at Morro. The results of this work were included on one topographic sheet, one hydrographic sheet, and one combined topographic and hydrographic sheet.

On the completion of this work the observer proceeded to Lompoc, Cal., and located the naval communication station at Point Arguello from points on the topographic sheet of the locality.

On September 12 the observer proceeded to Los Angeles, Cal., where information was obtained in regard to recent surveys by the United States Engineers at Newport Bay, Cal.

Work in the vicinity of San Diego was begun September 18.

The triangulation to check the positions of the aids to navigation and to determine additional points on the shores of San Diego Bay was completed in this month.

Topographic sheets were prepared and the topography of the bay on two sheets on a scale of 1:10,000 was completed in October and November.

The hydrography was begun in December. Advance information of the results of this work was furnished to the Naval Commission on Navy Yards and Naval Stations.

[L. O. COLBERT.]

**SUMMARY OF RESULTS.**—Leveling: 3 miles of levels run, 34 permanent bench marks established. Topography: 45.6 miles of general coast line surveyed, 45.6 miles of roads surveyed, 4.3 miles of railroads surveyed, 6 topographic sheets finished, scales, five 1:10,000, one 1:5,000. Hydrography: 64.2 square miles of area sounded, 52 square miles of area dragged, 140 miles run while sounding, 246 miles run while dragging, 599 positions determined (double angles) while sounding, 2,121 positions determined (double angles) while dragging, 2,210 soundings made, 12 tide stations established, 2 hydrographic sheets finished, scale 1:20,000, 2 wire-drag sheets finished.

In November, 1916, a party was organized for wire-drag work in San Francisco Bay.

Drag work was begun November 28 but was discontinued from December 8 to January 8 in order to complete a special hydrographic survey desired.

The limits of the dragged area extend from the Sisters to the 5-fathom curve south of Point Avisadero through the Golden Gate and Bonita Channel.

The effective depth dragged varied with the charted depths. In deep water the standard depth dragged was from 45 to 50 feet. Through the Golden Gate outside of Fort Point the depth averaged about 50 feet; inside the Golden Gate about 35 to 40 feet; in Bonita Channel about 45 feet; in the upper part of the bay from 28 to 47 feet, and in the lower part of the bay from 25 to 35 feet.

One important shoal with 29 feet of water over it was found about 1 mile northwest of Alcatraz Island.

A system of sounding lines was run across the bay from shore to shore about 1 mile apart. Additional lines were run inshore so spaced as to make the distance between about one-third of a mile.

Nine tide staffs were erected and observations made covering various periods during the hydrographic work in vicinity of each.

A topographic revision was made of the entire shore line of San Francisco Bay from Point Bonita to Point San Pedro, from Point San Pablo to San Leandro Bay, and from Hunters Point to the southern limits of Golden Gate Park. Triangulation points for the control of this work and for use by the hydrographic party were determined by E. W. Eickelberg.

The area covered by the instructions was completed on March 12, and the party left San Francisco for Seattle, Wash., March 17.

[E. F. DICKINS.]

An officer of the Survey has continued on duty as inspector for the coast of California and in charge of the suboffice of the Survey at San Francisco.

The inspector has obtained information for correcting the coast pilots and charts and has furnished tidal information and advance notices to mariners for publication in the newspapers. He has attended to the sale and issue of charts and other publications; has furnished information in regard to surveys to Government officials and others applying for the same; attended to the forwarding of instruments and supplies to the suboffice of the Survey at Manila; furnished transportation to officers of the Survey upon request;

supervised the repair and operation of the Presidio tide station; furnished data, instruments, etc., to field parties of the Survey; and attended to other miscellaneous duties.

## CALIFORNIA, OREGON, AND WASHINGTON.

[R. S. PATTON.]

The work of revising the Coast Pilot of California, Oregon, and Washington was in progress at the beginning of the fiscal year. A chartered launch was used in examining Puget Sound and adjacent waters, but owing to the small amount of funds available for this work, with a few minor exceptions never exceeding one day, no launches were hired during the remainder of this work.

The general plan adopted in the revision was to travel southward from one locality to the next until the entire coast had been covered, thus obtaining detailed information regarding the various localities, and then to return northward by steamer, changing boats as often as possible, in order to consult with the more experienced navigators on the coast regarding the particular application and usefulness of the volume to their profession.

The descriptive matter of the present volume was found to be excellent. As a rule the only alteration which it will require is in areas where artificial changes have been made.

The principal changes which are contemplated in the new edition are in the sailing directions, which require treatment from a broader point of view so as to emphasize those vital facts that affect navigation and that frequently can not be shown on the charts. Navigation on the Pacific coast is affected by a combination of two factors, fogs and currents, which present to the navigator problems not met elsewhere.

With a view to obtaining the benefit of what navigators had obtained by years of experience, a circular was addressed to most of the able navigators asking for statements on the following points: (1) The track commonly followed by them; (2) the forces which tend to cause deviation from the track, together with the conditions under which they become operative; (3) the methods and precautions used in thick weather to hold the track or guard against being set into danger; (4) any peculiar features which anywhere indicated the proximity to danger or served as a guide in rounding the various turning points; and (5) critical defects in the present charts.

A number of excellent letters were received in reply to this request that will be of material assistance in the preparation of the contemplated statement.

A careful study was also made of the records of investigations by the Steamboat-Inspection Service into the strandings on the coast in recent years, from which much valuable material was obtained.

During the progress of the coast pilot work, a special study was made of the problem of beginning a resurvey of the coast, working from a chartered vessel. Weather conditions, the availability of harbors, the best season for work, and the possibility of obtaining the necessary vessel were carefully considered.

All field work was completed on October 16.

WASHINGTON.

[JOHN A. DANIELS.]

**SUMMARY OF RESULTS.**—Reconnaissance: Length of scheme  $13\frac{1}{2}$  miles, 14 square miles of area covered, 95 lines of intervisibility determined, 38 points selected for scheme. Triangulation: 11 square miles of area covered, 40 signal poles erected, 37 stations in supplemental schemes occupied for horizontal measures, 51 geographic positions determined. Leveling:  $\frac{1}{2}$  mile of levels run, 3 permanent bench marks established. Topography: 27 miles of general coast line surveyed,  $2\frac{1}{2}$  miles of roads surveyed, 1 topographic sheet finished. Hydrography (wire drag): 21.9 square miles of area dragged, 134.8 miles run while dragging, 3,596 positions determined (double angles), 115 soundings made, 3 hydrographic sheets finished, scales 1:5,000, 1:10,000, and 1:20,000. Soundings: 2.3 square miles of area covered, 70.3 miles run while sounding, 745 positions determined (double angles), 2,367 soundings made, 1 tide station established, 2 hydrographic sheets finished, scales 1:5,000 and 1:10,000.

Between November 18, 1916, and March, 1917, wire-drag party No. 3 was engaged in surveys in Puget Sound and Port Orchard.

A scheme of triangulation was executed connecting the work by C. G. Quillian in 1915 with that by F. H. Hardy in the same year. It also connects with the work by Eugene Ellicott in 1880 and by George Davidson in 1856, although the latter connection is by a single point only.

The scheme was computed from the base Boulin-Boulder recovered from 1880 work of Eugene Ellicott. The distance and azimuth between these stations were obtained by an inverse computation, the values thus secured being carried through the scheme and checking closely upon the recovered stations.

The total scheme comprises 40 stations, 9 of which are former stations recovered, and 3 of which were unoccupied. There is a total of 58 closed triangles with an average closing error of 4.3 seconds.

The topographic revision indicated in the instructions—that is, the verification of the shore line and addition of changes in Port Orchard Bay, Agate Passage, and Port Madison—was completed as far as President Point and Point Monroe. The revision connects with the 1915 work of C. G. Quillian to the southward and with the work of F. H. Hardy during the same year in Liberty (Dogfish) Bay.

The sounding work consists of a thorough development of Liberty Bay northward from latitude  $47^{\circ} 42'$  by lines 100 meters apart and perpendicular to the axis of the channel. This work was plotted on a sheet of scale of 1:10,000. Agate Passage was also sounded with similar lines across the channel upon the same scale. The work in Agate Passage was done because of local reports that the depths in the passage had undergone extensive changes. The reported changes were not found and the soundings closely verify the general charted depths.

The small inlet upon the southern side of Port Madison was carefully sounded out upon a scale of 1:5,000, 50-meter lines being used. Very little change from charted depths was found except at the narrow part of the entrance to the inlet where a 4-foot shoaling was found, due probably to the accumulation of sawdust from the sawmill which has been operated until recently just inside the entrance.

The waters of Richs Passage, Sinclair Inlet, Port Orchard, Agate Passage, and Port Madison were swept by the drag. The depths

verified were approximately those charted up to 10 fathoms. The drag was swept so as to verify the 3-fathom curve, and great care was taken to thoroughly cover the area and develop all shoals. Several dangerous boulders and shoals were located in Agate Passage and in Richs Passage, and a depth of 23 feet was found upon a charted  $4\frac{1}{2}$ -fathom shoal south of Point Bolin.

The narrow passage into the inlet at Port Madison village has filled in since the last survey was made. It carries a depth of 9 feet now while the charted depth is 13 feet.

The sheet-metal floats used during the last part of the previous season in Alaska were used exclusively upon the work and proved satisfactory.

A device to keep the metal floats from flying back and injuring themselves and the deck of the launch was constructed. It was made of wood padded with old line and attached so as to yield when struck by the float. The device proved very useful in protecting boat and float and increased the safe speed possible in taking up the drag.

A reinforced wooden buoy holder that was attached by means of an ordinary oar socket proved useful for making changes in length of upright from the tender.

A new make of hoisting apparatus for large and small buoys was designed but was not tried out during the season.

[JOHN A. DANIELS.]

**SUMMARY OF RESULTS.**—Reconnaissance: length of scheme 8 miles, 16 square miles of area covered, 12 points selected for scheme. Base lines: 1 site for base line selected. Triangulation: 16 square miles of area covered, 7 signal poles erected, 12 stations in supplemental schemes occupied for horizontal measures. Topography: 15 square miles of area surveyed,  $29\frac{1}{2}$  miles of general coast line surveyed, 21 miles of roads surveyed, 3 topographic sheets finished, scale 1: 5,000.

Between April 6 and June 30, 1917, topographic revision work was done along the Lake Washington Canal from Shilshole Bay to Lake Washington, including the changed shore line of Salmon Bay and Lake Union and also the changed topography between Salmon Bay and Smith's Cove. Revision in the vicinity of Alki Point was under way at the end of the fiscal year. During the same time the triangulation was extended from the vicinity of Salmon Bay to Smith's Cove, across Elliott Bay and southward along the Duwamish Valley to South Park, the scheme being approximately 10 miles long.

A base site was selected along the Duwamish River and the necessary observing done to connect with the triangulation. Preparations for measuring the base were nearly complete at the end of the fiscal year.

[PAUL M. TRUEBLOOD.]

**SUMMARY OF RESULTS.**—Hydrography: 18 tide staffs erected for comparative readings, 2 tide stations established, 62 permanent bench marks established, 6 current stations occupied.

In February a tidal and current survey of the southern part of Puget Sound was begun, the launch *Wanick* having been chartered for the use of the party.



The first work done was the establishment of automatic tide gauges at McNeil Island and Allyn. Bench marks were placed at the same time. The tidal work was taken up at South Colby, Burton, and Gig Harbor. The general plan adopted was to work to the south toward the more remote and less important places. An effort was made to make the current observations simultaneously with the tidal observations, but stormy weather conditions and other causes made this impracticable. The period from March 18 to April 3 was practically one continuous storm. Operations were delayed considerably by the strong southerly winds and rough weather. During this time the bulkhead in the new King County Ferry Dock at Des Moines was carried away and with it the tide staff for that place. No levels had been run on account of the persistent bad weather since the observations were made. No permanent mark was therefore left at this station.

An automatic tide gauge was established on the Federal penitentiary wharf at McNeil Island, where two bench marks were placed and observations continued for two months.

McNeil Island was chosen as a location because it is central to the tidal basin from The Narrows to Johnson Point, including Carrs Inlet. The tide staffs at Steilacoom, Dupont, Arletta, Wanna, Home, Longbranch, and Libbeys Ranch (Henderson Inlet) were referred to this gauge.

Another automatic gauge was established at Allyn and operated for a month. This served to determine the type of tide at the head of Case Inlet.

Observations at South Colby, Des Moines, and Burton were referred to the automatic gauge maintained by the Survey at the foot of Madison Street, Seattle.

An automatic gauge belonging to the Survey was maintained by the field engineer of the State of Washington at Olympia. This gauge had been in operation for about eight months.

Eighteen tide staffs were erected and determined by comparative readings with the automatic gauges. Readings were taken every 10 minutes for an hour before and after high and low water and every hour between high and low water. Sixty hours was the shortest series and a number of them were from 84 to 96 hours.

Three permanent bench marks were put in at each station and were connected with the tide staffs by accurate lines of levels.

Current measurements were made both from the launch and from wharves by the tidal observers.

Observations were made from the launch in the north end of Colvos Passage on three days. The maximum velocity observed was 1.2 knots.

At Point Robinson observations were made for 49 hours from an anchorage 200 meters off the light. The maximum velocity observed was 0.94 knot.

A series of 20 hours was obtained in the southern part of The Narrows. A velocity of 2.65 knots was observed. This series is incomplete.

Additional observations were made by the tide observers at Dupont, Arletta, and Boston Harbor, which give some idea of the relation of the eddy currents at those points to the tides. Observations

of the time of slack water and approximate direction of the current were made at Steilacoom, Grant, Arcadia, South Colby, Vaughn, and Totten Inlet.

Field work was closed on April 16.

[C. G. QUILLIAN, Commanding Steamer *Patterson*.]

During the winter of 1916-17 some work was done on the survey of the Lake Washington Ship Canal.

The scheme of triangulation laid out by G. T. Rude several years ago was followed, the connection of the canal with Smith Cove practically finished, and a few additional stations established. Topographic projections were laid out and good progress was made on one sheet.

In the latter part of March this work was turned over to J. A. Daniels.

Magnetic observations were made at Restoration Point and a new magnetic station established while the vessel was at Winslow for docking.

After returning to Seattle, observations were made at the established station located in Seward Park.

[T. J. MAHER, Commanding Steamer *Explorer*.]

**SUMMARY OF RESULTS.**—Triangulation: 2 square miles of area covered, 3 signal poles erected. Leveling: 2 miles of levels run, 3 permanent bench marks established. Azimuth: 1 station occupied for azimuth observations. Topography:  $\frac{1}{2}$  square mile of area surveyed, 2 miles of general coast line surveyed. Hydrography:  $\frac{1}{2}$  square mile of area sounded, 10 $\frac{1}{2}$  miles run while sounding, 1,264 positions determined (double angles), 632 soundings made, 2 tide stations established, 4 current stations occupied, 1 hydrographic sheet finished, scale 1:2,500.

A survey of two lanes across Richs Passage was made. Work had been done in this vicinity a number of years ago which was sufficient for navigation, but the lines of soundings did not parallel the direction of the lanes along which soundings were now required. A survey was made on a scale of 1:2,500, which was as large as could be conveniently handled in plotting.

Prior to taking up this survey the party was engaged on current work in the same locality. This work was extended somewhat beyond what was called for in the instructions using the same data. Some additional signals were located by planetable.

A tide staff was erected on the Fort Ward dock. A tide staff which had apparently been used by some other survey party was found on the Pleasant Beach dock, and simultaneous observations were begun. Certain bench marks in the vicinity of Pleasant Beach were connected by leveling with the tide staffs. Six high and six low waters observed at Ford Ward were used in deriving a plane of reference for this work. These were referred to Seattle as the main station.

Soundings were made with a launch sounding machine and located by sextant angles taken to the launch by observers at triangulation stations on shore. Only one line of soundings in each of the two directions was required. Five lines over each direction were run. Additional soundings were made over areas where soundings appeared irregular.

## GEODETIC WORK.

## MAINE AND NEW YORK.

[JOHN D. POWELL.]

**SUMMARY OF RESULTS.**—326 miles of levels run, 237 permanent bench marks established.

Work on the line of precise levels in Maine between Boundary and Vanceboro, preparations for which had been begun in June, 1916, was continued from July 1 until September 19, when field operations on this line were completed.

This line across the State of Maine followed the lines of the Canadian Pacific Railway and the Maine Central Railroad.

On September 19 the work in Maine having been completed, the party and equipment were moved to Rouses Point, N. Y., but on account of delay in securing the permission from the Delaware and Hudson Co. to use motor cars over their tracks, work was not started at that point until October 4. The work in New York was extended to Whitehall, after which the weather was so severe the season's work was closed and the party was disbanded.

The line of levels across the State of Maine afforded a connection between lines of precise levels run by the Geodetic Survey of Canada.

The line drops sharply from Boundary on a 1.6 per cent grade. The country is very rugged, and curves and deep cuts are numerous. The towns passed include Holeb, Jackman, Greenville, Brownville, Mattawamkeag, and Vanceboro. Commencing at Holeb the line runs for 100 miles through the lake region, and here lakes, small ponds, and connecting streams are on every hand. Lumbering is the principal industry and most of the towns are simply small lumbering camps which afforded no accommodations for the leveling party.

East of Mattawamkeag the right of way is the property of the Maine Central Railroad Co. This portion of the line stretches for 56 miles over a rolling country with steep grades and numerous curves.

At Vanceboro connection was made with bench marks of the Canadian survey. The elevations as recorded by the Canadian survey and the Coast and Geodetic Survey differ by only a very small fraction of a meter.

The work in the State of New York lay along the line of the Delaware & Hudson Co. tracks. It passed through the towns of Plattsburg, Westport, Port Henry, Crown Point, and Whitehall. It started from bench marks of the United States Coast and Geodetic Survey and the Geodetic Survey of Canada. South from Rouses Point the line followed closely the rocky shores of Lake Champlain. Almost constant rock cuts, sharp curves, narrow passes, and several tunnels made the road a very dangerous one to level over. Two velocipede motor cars were used in this work. On one of these the instrument tripod was mounted.

Standard bench marks were set on an average of one for every 2 miles. All bench marks were on ledge rock, large boulders, railroad structures, or public buildings. Besides these a number of temporary bench marks were used to limit the lengths of section to about 1 mile.

## MASSACHUSETTS, RHODE ISLAND, AND CONNECTICUT.

[H. P. RITTER.]

Topographic determinations were made of the locations of radio stations at New London, Conn., on October 18, and at Newport, R. I., on November 26. In each case the station was identified and its position plotted by distances measured with a steel tape to near-by located points shown on the chart, and the latitude and longitude scaled. Afterwards the position of each station was verified in the office by plotting it on the latest planetable sheet. .

The naval radio station at North Truro, Mass., was visited by the same observer in August (while engaged in other work at Provincetown) and found by inspection to be located as shown on Coast and Geodetic Survey chart No. 341.

## CONNECTICUT.

[H. P. RITTER.]

On September 30, 1916, a revision was begun of the triangulation and topography on the south shore of Connecticut between the easterly end of the Norwalk Islands and New Haven, Conn.

The work was begun by an examination and re-marking of the triangulation stations in the vicinity of the coast.

Between September 29, when the work began, and November 3, when the work was discontinued, 88 triangulation stations were visited and examined.

## NEW YORK.

[ISAAC WINSTON.]

In May, 1917, a determination was made by triangulation of the geographic position of the tower of the Woolworth Building in New York City, the most conspicuous object on Manhattan Island, reaching to a height of 750 feet, and also the geographic position of the Ambrose Channel Range Rear Light.

Three stations of the triangulation of Greater New York, Standish Arms, Prospect Water Tower, and Schoolhouse 142 in Brooklyn, were recovered and occupied for observations to determine the geographic position of the Woolworth Building tower, and three light-houses, Coney Island Light, West Bank Light, and Old Orchard Shoal Light, were used to determine the position of Ambrose Channel Range Rear Light.

On account of the necessity of calm weather for landing at Old Orchard Shoal Light, observations were not made at that station.

## NEW YORK, NEW JERSEY, CONNECTICUT, RHODE ISLAND, AND MASSACHUSETTS.

[J. E. McGRATH.]

SUMMARY OF RESULTS.—Triangulation: 8 square miles of area covered, 21 geographic positions determined, 1 elevation determined trigonometrically. Leveling: 3 miles of levels run.

During the period from April 9 to May 22, 1917, determinations were made of the geographical positions and heights above sea level of a number of wireless stations on the Atlantic coast, and a connection was made between the observatory of Columbia University in New York City and the triangulation scheme of New York City.

The geographic positions were determined of the radio stations at Belmar, N. J., New Brunswick, N. J., T. A. Scott & Co. at New London, Conn., and the National Electric Signalling Co., at Newport, R. I.

The elevations of the bases of radio stations with reference to sea level were determined, as follows: Marconi wireless masts at Belmar, N. J.; Marconi wireless masts at New Brunswick, N. J.; Marconi wireless masts at Seagate, N. Y.; American Commercial Co. mast at Sayville, N. Y.; Marconi wireless mast at Sagaponack, N. Y.; T. A. Scott & Co. masts at New London, Conn.; National Electric Signalling Co. mast at Newport, R. I.; Marconi wireless masts at Siasconset, Mass.; Marconi wireless masts at South Wellfleet, Mass.; and Marconi wireless masts in Boston, Mass.

In New York City the observatory of Columbia University was connected with the primary triangulation in New York City by means of a 1,200-foot traverse.

## NEW YORK, NEW JERSEY, PENNSYLVANIA, AND MARYLAND.

[O. W. SWAINSON.]

Between March 14 and April 1, determinations were made by triangulation of the geographic positions and elevations of the ground at the bases of radio stations at Annapolis, Md., Baltimore, Md., Philadelphia, Pa., Cape May, N. J., Tuckerton, N. J., and New York, N. Y.

The observer was then instructed to close work and arrange to take charge of a precise leveling party in Texas.

## DISTRICT OF COLUMBIA.

## PENDULUM INVESTIGATIONS.

[C. L. GARNER AND MAX STEINBERG.]

Certain investigations were made in connection with the pendulum observations to determine the effect on their periods of the various conditions under which they are used. The detailed results are of special interest only and will be reported on in detail in some future special publication on the determination of the intensity of the force

of gravity. As one of the results of the investigations it was found that the pendulums have slightly different temperature coefficients from those previously used. With the use of the new coefficients, the periods of the pendulums at the base station at Washington, D. C., were found to be more accordant than when the earlier coefficients were used.

[C. V. HODGSON AND MAX STEINBERG.]

**SUMMARY OF RESULTS.**—Reconnaissance: Length of scheme 14 statute miles, 115 square miles of area covered. Triangulation: 115 square miles of area covered, 17 stations in main scheme occupied for horizontal measures, 24 geographic positions determined.

In pursuance of instructions issued in January, 1917, a reconnaissance was made for the extension of the triangulation in the vicinity of the District of Columbia to furnish some control points in Maryland for the Washington Suburban Sanitation Commission on or near the line of the proposed new sanitation district. As a result of the reconnaissance it was decided that tertiary triangulation would furnish all the accuracy required in the results. Primary triangulation would require much more time, and therefore it was concluded that the work should be only tertiary in character, extending from such tertiary triangulation as was available in the District.

The necessary reconnaissance was made as rapidly as the weather and poor condition of the roads would permit, and six points were found directly on the proposed boundary which could be easily located, besides others in the interior of the sanitation district. The observation of angles was begun on February 21 and continued at such times as the weather permitted up to the end of March. During that time 16 stations were completed and observations were partly completed at the remaining two stations of the scheme. Signal lamps were used exclusively on account of the thick atmosphere.

The charge of the party was transferred to another officer on April 1.

At the time of transfer the remaining stations were Ken and Chevy. These stations were located on stand pipes 120 and 140 feet in elevation, and observations were difficult on account of continuous winds. On April 4 and again on the 11th the wind subsided, and the field work was then completed.

#### DISTRICT OF COLUMBIA AND MARYLAND.

[J. D. POWELL.]

**SUMMARY OF RESULTS.**—Leveling: 72 miles of levels run, 32 permanent bench marks established.

On February 19 field work was begun on a line of levels between a bench mark on the Capitol Building at Washington, D. C., and the Naval Proving Ground, Indian Head, Md. The field work was completed March 31, 1917.

The line runs from the bench mark at the window sill at the south side of the Senate wing of the Capitol Building, northeastward along Maryland Avenue to Ninth Street, thence north to Florida Avenue, thence east to the intersection of Benning Road. From this point

it continues along the tracks of the Washington Railway & Electric Co. to Seat Pleasant, thence along the track of the Chesapeake Beach Railroad Co. to Upper Marlboro where it changes to the tracks of the Pennsylvania Railroad Co. and continues thereon to White Plains, Md. At White Plains the county road passing through Pamfret and Pamunkey was followed to Indian Head.

A branch of the above line was later extended from White Plains to Pope Creek for the purpose of supplying bench marks at a point on the Potomac where the mean level of the water would most likely be identical with mean sea level.

The entire work was done on foot, and because of this fact as little equipment as possible was carried.

Good progress was made in spite of the slower method of traveling. A maximum of  $12\frac{1}{2}$  miles per day was attained and on several days 10 to 12 miles were accomplished.

Bench marks were set on the average of one for every 2 miles. These were concrete posts with metal discs inserted. They were constructed in the office of the Survey.

#### MARYLAND AND VIRGINIA.

[L. A. POTTER.]

Between September 5 and 23, 1916, an inspection was made of the triangulation stations in the vicinity of Tangier Sound, in cooperation with representatives of the engineering departments of Maryland and Virginia, who were engaged in placing beacons and buoys to permanently mark the boundary line between the two States.

Eighteen stations were inspected and 10 were recovered. Of those not recovered, 3 were restored by the Maryland and Virginia engineers after making the necessary observations and computations.

Many of the stations in the vicinity of Tangier and Pocomoke Sounds had been established on marsh land, close to the high-water line, and the reference marks had been established close to the station marks, and in many cases both had been washed away. This appears to be the principal cause of the loss of stations in this vicinity.

#### WEST VIRGINIA, MARYLAND, NEW JERSEY, AND CONNECTICUT.

[MAX STEINBERG.]

**SUMMARY OF RESULTS.**—Gravity determinations: 9 pendulum stations occupied.

During the season from April 16 to June 16, 1917, determinations of intensity of the force of gravity were made at nine stations, as follows: Clarksburg, Rowlesburg, Terra Alta, and Corinth, W. Va.; Kitzmiller, Md.; Pennington, Glen Ridge, and Plainsboro, N. J.; and Hartford, Conn.

This work was undertaken at the request of the Director of the United States Geological Survey. From previous gravity determinations it was known that the anomalies at stations Deer Park and Princeton are positive, while at all surrounding stations the anomalies are negative. The additional gravity stations were established in order to define the area of positive anomaly and correlate

it with the geological formations of this region. A station was also established at the Jervis Laboratory of Trinity College, Hartford, Conn., in response to a request from the authorities of the college.

At the termination of the previous field season all of the pendulums were riveted and restandardized. Until the office computations are made no conclusion can be drawn as to the effect of riveting the pendulums.

Toward the close of the season, a new temperature-proof case for use in carrying the hack chronometer from the gravity station to the telegraph office was provided. By its use the uncertainty as to the rate of the chronometer is made very small.

Noon-time signals from the Naval Observatory at Washington, D. C., were obtained over the Western Union Telegraph Co. wires for use in this work.

Field work was begun at Clarksburg, W. Va., April 16, 1917, and closed at Hartford, Conn., June 16, 1917. In that time nine stations were completed making the average time per station  $5\frac{1}{2}$  days.

#### NORTH CAROLINA.

[J. S. BILBY.]

In January a reconnoissance was begun for primary triangulation and a primary traverse between some point on Cape Fear River or the coast in the vicinity of Wilmington, N. C., and two or more stations of the oblique arc in the vicinity of latitude  $35^{\circ} 30'$  and longitude  $81^{\circ} 00'$ . The observer proceeded to Greensboro, N. C., arriving there January 17.

During the period from January 17 to 25, stations Moore, King, and Young were recovered.

On January 24 orders were issued to suspend reconnoissance work in North Carolina in order that the chief of party might take up more urgent duties in Florida.

#### GEORGIA.

[J. S. BILBY.]

At the beginning of April orders were issued to make a reconnoissance for a line of primary traverse from Brunswick to Columbus, Ga., by way of Macon, and to erect signals and place marks at the angle stations of the line. This work was done in cooperation with the party under charge of C. V. Hodgson, to whom the actual tape and angle measurements were assigned.

A subparty was organized for building the signals and placing the monuments.

By May 22 the signals had been built, stations marked, curves staked, and line prepared from Brunswick to a point 10 miles to the westward of Hazelhurst, Ga., a distance of 100 miles.

On May 22 the work being done by this party was transferred to C. V. Hodgson, who had charge of the measuring of distances and angles in the traverse.



## FLORIDA.

[J. S. BILBY.]

**SUMMARY OF RESULTS.**—Triangulation: 19 hydrographic signals erected (10 of 100 feet in height and 9 of lesser height), 19 geographic positions determined.

Between January 27 and March 25, 1917, the building of tall hydrographic signals on the coast of Florida, which had been begun under another chief of party, was continued.

Work was begun in the vicinity of Pablo Beach with the building of a signal at station Pablo.

As the building progressed, the positions of the signals were determined either by invar tape traverse or by triangulation. The geographic positions and descriptions of the stations were furnished to the commanding officer of the steamer *Isis*, who was engaged in hydrographic work along the Florida coast.

Ten of the signals, which were each 100 feet in height, carried targets which were 16 feet wide and 50 feet long. The other nine signals, which were less than 100 feet in height, had targets which were 10 feet high and 16 feet wide.

## FLORIDA AND GEORGIA.

[E. H. PAGENHART.]

**SUMMARY OF RESULTS.**—Primary traverse: 178 miles measured with tapes on traverse line, 42 signal poles erected, 80 observing tripods and scaffolds built, average height of observing tripods and scaffolds 4.8 feet, 91 stations occupied for horizontal measures, 94 geographic positions determined, 10 miles of levels run.

On March 31 instructions were issued for a primary traverse to be run between Jacksonville, Fla., and Columbus, Ga., via Waycross and Albany, following the Atlantic Coast Line Railroad from Jacksonville to Albany and the Seaboard Air Line Railway from Albany to Columbus; measurements of the distance to be made on the rails with invar tapes, and the angles to be measured with a 12-inch theodolite; all work to be of such accuracy as to make the line a part of the primary control for horizontal positions in the United States, supplementing the primary triangulation; the reduction of the line to the horizontal to be made from the elevations and profile supplied by the precise-level line to be run over the same route between Jacksonville and Columbus; preliminary field positions to be furnished to officers of the Geological Survey who might desire the data for their field work.

The entire work is through timbered country. From Jacksonville to Brookfield, a distance of 150 miles, the country is level and sandy; from Albany to Dawson, a distance of 25 miles, although it is rolling, there are long tangents. Traverse is well suited for both sections.

From Brookfield to Albany, a distance of 50 miles, and from Dawson to Columbus, a distance of 60 miles, the country is rough and heavily timbered, the tracks have many cuts and fills, and the curves are numerous, sharp, and long, making the country less favorable for traversing than the remainder of the line.

Actual field work on reconnoissance was begun at Jacksonville, Fla., on April 10, when connection was made with the coast triangulation, and the reconnoissance and signal building extended along the Atlantic Coast Line Railroad for 190 miles to the vicinity of Albany, to which point this work had been completed at the end of the fiscal year; 122 stations were located and marked, and necessary stands, signals, and poles were erected for the observing.

In the flat country it was found that a maximum of 4 miles, with an average of  $2\frac{1}{2}$  to 3 miles, gave the most economical length of line for the construction and observing.

All tripods up to 36 feet were built of 2 by 4 lumber, and have proven of sufficient strength; they were all framed and set up at the lumber yard and carried to place on the gas cars. The tripods less than 14 feet high had no scaffold built around them; the observing party carried with them a temporary platform, which was used at these stations.

Whenever the scheme which follows the track had many short lines making it inadvisable to carry the azimuth through them, as was the case from Enigma to Willingham, other stations were established from 3 to 5 miles apart, through which the azimuth was carried; those stations were connected to the traverse by tape, or by observations from at least three of the rail stations. The supplementary stations along the rails were designated by the name of the southern station, and were given the subscript A, B, C, etc. They were marked permanently wherever possible with regular marks having the name stamped on the disk. Many of the supplementary stations were located on the railway track and could not well be permanently marked.

The tape work was begun at Jacksonville, April 10, following close after the reconnoissance. A double line was completed to the vicinity of Willingham at the close of the fiscal year, a distance of 178 miles, 16 miles of which were measured over stakes, and 162 miles along the rails.

Over several sections, one of the measures, either forward or backward, was made in the rain. Previous work in the rain showed that there is apparently a suction between the heavier tape, due to the water remaining on it, and the wet rail that caused a shortening in each tape length of 1 mm. This correction was applied on those sections.

At offset stations along the tangents the instrument was set up over the rail point and the angle between the rail and the station was measured with a 4-inch theodolite. A direct and reverse reading with a direct check reading were taken.

A Wye level, without any protection from the sun, was used in running levels over the stakes. The steel wheel glass cutter was used in marking the rail. All measurements made with the steel tape were checked by a reading in feet on the reverse side.

Sixteen positions with the 12-inch direction instrument were taken at all main scheme stations, and a double set of six repetitions direct and reverse with a 7-inch repeater was observed at all supplementary stations.

All observations with both instruments were made on targets, except where a heliotrope or lamp was necessary to observe a line when tar-

gets could not be seen. An azimuth carried through a single line under generally unfavorable conditions as to lateral refraction is the weakest part of a traverse; therefore additional lines were observed wherever practicable. The time required was about the same for the primary as for the supplemental stations. Four primary stations were sometimes occupied in one day.

#### FLORIDA, GEORGIA, AND ALABAMA.

[GEORGE D. COWIE.]

**SUMMARY OF RESULTS.**—462 miles of levels run, 168 permanent bench marks established.

After completing the line of levels from Cedar Keys, Fla., to St. Augustine and Fernandina, Fla., and from Baldwin, Fla., to River Junction, Fla., this party began on July 1 the line from Tallahassee, Fla., to Atlanta, Ga., and from Atlanta carried it to a point about 16 miles from Birmingham, Ala., where work was temporarily suspended for the season. The line run follows the Georgia, Florida & Alabama Railroad, from Tallahassee, Fla., to Richland, Ga.; thence via the Seaboard Air Line Railway to Columbus, Ga.; thence via the South Georgia Railway to Harris, Ga.; thence via the Atlanta, Birmingham & Atlantic Railroad to Woodbury, Ga. From Woodbury the line follows the Southern Railway Co. tracks into Atlanta, Ga., via Williamson and McDonough, Ga. From Atlanta the line follows the Seaboard Air Line Railway tracks toward Birmingham, Ala.

Progress in July was delayed by rain during two weeks and in August by the breaking down of the motor cars. From that time until the middle of September the work was done on foot. About this time a motor car and two velocipedes were received from another party, and these were used on the remainder of the line to Atlanta and a few miles beyond. These velocipedes of the bicycle type were used a while but were abandoned as not being of much use on a grade or in a wind. The motor car was in bad condition and after several minor accidents was also abandoned. The work was then continued on foot until about December 10 when the two repaired motor cars were received from the factory. During this work connections were made with a number of bench marks of the United States Geological Survey and with several of those of the United States Engineers. Agreement with the former was very close, that at Atlanta being within 2 or 3 inches. The average progress of the party was only 80 miles per month with about 8 per cent re-running. The maximum month's progress was 97 miles and was made in July while the party used cars. The second best month was November when 90 miles were run, the party walking during the entire month, and traveling to and from work in passenger trains.

The line started at an elevation of about 50 feet above sea level and reached its highest point near Dallas, Ga., at an elevation of about 1,100 feet, then dropping to 600 feet by the close of the year.

The total progress was 462 miles. Bench marks were set at a distance of about  $2\frac{1}{2}$  miles apart throughout the entire line.

## SOUTH CAROLINA.

## RECOVERING AND RE-MARKING TRIANGULATION STATIONS.

[E. B. LATHAM.]

Between April 19 and May 26 field work was done for the purpose of recovering and re-marking triangulation stations on the coast in the vicinity of Charleston, S. C.

All stations with one exception were either recovered or found to have been destroyed. In all 33 stations were recovered, some of them re-marked, and then descriptions were brought up to date where this was found to be necessary.

Where practicable, arrangement was made with the owners of land upon which stations are situated or with persons living in the vicinity to inform the Coast and Geodetic Survey office of the condition of the station, when requested by letter.

The recovered stations furnish a continuous chain of triangulation along that portion of the coast which extends from a point 30 miles eastward of Charleston to a point an equal distance to the westward, except from the western end of Bull Bay to a line north of Capen Inlet, a distance of about 8 miles.

Notes relating to triangulation stations in the immediate vicinity of Charleston were obtained from the office of the District Engineer, Corps of Engineers, United States Army, at Charleston.

## GEORGIA.

[O. W. FERGUSON.]

**SUMMARY OF RESULTS.**—Leveling: 140 miles of levels run, 162 permanent bench marks established.

On April 11, 1917, preparations were begun at Brunswick, Ga., for running a line of precise levels from that place to Columbus, Ga., by way of Macon.

The preliminary arrangements of organizing the party, obtaining the necessary instruments and equipment, and preparing bench marks having been completed, actual field work was begun on May 6 and was continued from that time to the end of the fiscal year. In this time 139.8 miles of leveling was done, and 162 permanent bench marks were established. The work was completed to a point 5 miles beyond Eastman, Ga.

The line of levels followed the route of the Southern Railway.

Connections were made whenever practicable with bench marks of the United States Geological Survey and of the Southern Railway.

The routes followed by this precise leveling party and the primary traverse party under Mr. Hodgson, are identical.

The leveling party furnished such data to the traverse party as were necessary to enable the latter to compute the grade corrections to the distances measured along the tangents of the railroad.

[C. V. HODGSON.]

**SUMMARY OF RESULTS.**—Reconnaissance (for traverse): Length of scheme 175 miles, 127 stations selected. Base lines: 1 secondary, 1,400 meters in length. Primary traverse: Length of traverse, 169.7 statute miles, 127 observing tripods and scaffolds built, 118 stations in main scheme occupied for horizontal measures, 8 supplemental stations occupied for horizontal measures, 135 geographic positions determined. Astronomic work: 5 azimuth stations occupied. Leveling: 29 statute miles.

In the early part of April arrangements were begun to run a line of primary traverse from Brunswick to Columbus, Ga., via Macon.

Reconnaissance and signal building were carried on by a separate party under J. S. Bilby from April 16 to May 21. On the latter date this work was taken over by the main traverse party. The traverse was started from stations of the coast triangulation in the vicinity of Brunswick, Ga., and extended toward Macon along the Southern Railway line. The measurements were made along the tops of the rails of the railroad on the tangents, but the tapes were supported by stakes in the same manner as in base measurement at the curves.

The measurements of distance were made with invar base tapes, 50 meters in length. At the points in the traverse where there were changes in direction, angles were measured with a 12-inch theodolite as in primary triangulation. At intervals the astronomic azimuth of lines of the traverse was determined by observations on Polaris.

A precise-leveling party operated along the same route as was followed by the traverse party, in order to furnish the data necessary for the latter to reduce the distances measured to the horizontal plane. The traverse party did the leveling over the stakes supporting the tape when measuring at the curves.

The first hundred miles of the line was well adapted for traverse work. Although curves were not infrequent the topography usually permitted the stations to be spaced a sufficient distance apart to insure strength in carrying the azimuth. The latter part of the line was much more curved and the adjacent topography was such that the traverse could not be strengthened by triangulation except at a prohibitive cost. On the portion run during June, 22 miles were on stakes out of a total of 69 miles, and the angle stations averaged only about a mile apart. The progress of the work was materially reduced on this section by the extra building, clearing of lines, and setting stakes for measurement around curves.

By the close of the fiscal year the traverse had been completed to within about 15 miles of Macon.

#### GEORGIA AND FLORIDA.

[G. D. COWIE and C. L. GARNER.]

**SUMMARY OF RESULTS.**—Leveling: 251 miles of levels run, 114 permanent bench marks established.

Precise leveling on the line from Jacksonville, Fla., to Columbus, Ga., along the Atlantic Coast Line Railroad and Seaboard Air Line Railway, was continued from April 9 to the end of June.

This work was begun by Mr. Cowie after he had completed a line of precise leveling to Mobile, Ala., and was transferred to Mr. Garner at Waycross, Ga., on April 19.

The work consisted of a regular line of precise levels, and extra observations were made which made it possible for the traverse party under E. H. Pagenhart to determine grade corrections to the measured distances. The line of the levels and of the traverse is identical. The line of levels to Columbus was nearly completed by the end of the year, there being only two and one-half days' work to finish the line.

At Kimbrough, Ga., a distance of 232 miles from Jacksonville, a connection was made with a bench mark established in the preceding year by G. D. Cowie.

At Richland, Ga., 6 miles from Kimbrough, the line again joined the work of Mr. Cowie. From this place to Columbus, Ga., the line of the previous work was followed, but only a single line was run. This was for the purpose of furnishing a profile of the railroad along which the leveling was done in order that the traverse party might make corrections to the measured distances to obtain the horizontal distances.

The total number of permanent bench marks on the line from Jacksonville to Richland, a distance of 238 miles, is 114, an average of a permanent mark every 2.1 miles. There are also a number of subsidiary bench marks on that section of the line from Jacksonville to Folkston, Ga., which are on the bases of semaphore poles and are really permanent in character. Mention should also be made of the railroad bench marks from Jacksonville, Fla., to Folkston, Ga., to which connection was made. These were also on the bases of semaphore poles and are almost permanent in character.

A list of the elevations and descriptions of permanent and temporary bench marks between Jacksonville, Fla., and Waycross, Ga., was furnished field officers of the United States Geological Survey operating in Georgia.

#### ALABAMA, FLORIDA, GEORGIA, SOUTH CAROLINA, NORTH CAROLINA, AND VIRGINIA.

#### DETERMINATION OF THE GEOGRAPHIC POSITIONS AND THE ELEVATIONS OF RADIO STATIONS—INSPECTION OF TIDAL STATIONS.

[W. B. FAIRFIELD.]

Between April 12 and June 28 determinations were made of the geographic positions of a number of radio stations on the Gulf and Atlantic coasts between Mobile, Ala., and Virginia Beach, Va.

At Fort Morgan, Ala., various tidal bench marks were inspected and found to be in good condition.

At Cedar Keys, Key West, St. Augustine, and Fernandina, Fla., the tide stations and bench marks were inspected and lines of levels run connecting the tide gauges and bench marks.

The positions of the radio stations were determined at Pensacola, Fla.

At Tampa, Fla., the elevation of the ground at the foot of the wireless station was determined.

At Key West, Fla., the positions of two naval radio stations were determined by triangulation. At Miami, Fla., the position of the Marconi radio station and the elevation of the ground at its foot were determined by triangulation.

The position of the radio station at St. Augustine, Fla., and the elevation of the ground at its foot were determined.

At Savannah, Ga., the elevation of the ground at the Marconi wireless station was obtained from data furnished by the city engineer.

At Buxton, N. C., the position of the Marconi radio station and the elevation of the ground at its foot were determined by triangulation.

A determination was made of the elevation of the ground at the foot of the Marconi radio station at Virginia Beach, Va., from bench marks of the Norfolk Southern Railroad Co.

Field work was closed on June 27.

#### LOUISIANA AND ALABAMA.

[O. W. FERGUSON.]

Between March 15 and April 9 a determination was made by triangulation of the geographic positions of eight radio towers in New Orleans and Algiers, La., and two at Mobile, Ala.

The elevation of the ground at the base of these towers was determined by leveling.

#### TEXAS.

[J. D. POWELL.]

**SUMMARY OF RESULTS.**—Precise leveling: 205 miles of levels run; 115 permanent bench marks established.

A line of levels from Sierra Blanca to San Antonio, Tex., was undertaken at the request of the War Department in order to furnish precise elevations to the topographic parties of the United States Geological Survey working on military topographic maps in the Big Bend region of Texas.

Two parties were assigned to the work with instructions to carry the elevations through on single lines and later check back after the immediate needs of the topographers had been supplied. Mr. Powell's party worked from previously established bench marks at Allamore and Sierra Blanca eastward to Marfa. A party under O. W. Swainson took up the work at the latter point and carried it to Del Rio. Mr. Powell moved from Marfa to Del Rio and made about 100 miles of progress to the eastward of that point before the end of the fiscal year.

The route lay along the Galveston, Harrisburg & San Antonio Railway, a portion of the Sunset Route of the Southern Pacific Co. The principal towns along the way were Sierra Blanca, Hot Wells, Valentine, Marfa, Alpine, Sanderson, Langtry, and Del Rio.

The work was greatly retarded by unfavorable weather.

[O. W. SWAINSON.]

**SUMMARY OF RESULTS.**—Precise leveling: 85 miles of levels run, 44 permanent bench marks established.

On May 1, 1917, a party was organized at Alpine, Tex., for the purpose of running a line of precise levels from that place westward along the line of the Southern Pacific.

This leveling is a portion of that called for by the War Department for the purpose of furnishing exact elevations to be used in con-

trolling elevations used by the United States Geological Survey when making military topographic maps in the Big Bend region.

After establishing bench marks between Marfa and Sanderson and collecting the necessary instruments and equipment, leveling work was begun on May 14 westward from Alpine. When the line had been completed westward to Marfa and eastward to Altuda the party moved to Marathon. From that time until June 30 leveling was continued to the eastward. By that date the line was completed to Tesnus, Tex.

Two new motor velocipedes were used in this work.

Standard concrete post bench marks were set every 2 miles along the railway. Temporary bench marks consisting of railway spikes driven in telegraph poles were established every other mile between the permanent bench marks.

Descriptions and elevations of bench marks were furnished as soon as they were available to field officers of the United States Geological Survey.

[J. B. BOUTELLE.]

**SUMMARY OF RESULTS.**—Triangulation: 8 square miles of area covered, 5 signal poles erected, 6 stations in main scheme occupied for horizontal measures, 6 geographic positions determined. Leveling: One permanent bench mark established, 3 miles of levels run.

In April a determination was made by triangulation of the position of the radio towers at Point Isabel and Beaumont, Tex.

Stations East Base and South Base about 3 or 4 miles west of the point were recovered, and a new station Ranch was established on the south end of the point. The radio towers and Brazos Santiago Lighthouse were observed from these stations and from the tower of the old Point Isabel Lighthouse. A line of levels was also run from mean low water to the radio towers.

After completing observations at Point Isabel, the observer returned to Galveston on April 12 and left again on the 15th for Beaumont, Tex. Triangulation stations Cut-off and Spindle Top of the United States Engineers were recovered, and the radio towers of the Magnolia Petroleum Co. were observed from those stations. A line of levels was run from the United States Engineers' station Beaumont to determine the height of the towers above mean low water. On completing these observations, the observer proceeded to Port Arthur and determined the height above mean low water of the Marconi radio tower at that place. This work was completed on April 20 and the observer returned to Galveston.

[J. S. BILBY.]

On June 6, 1917, arrangements were begun for making a reconnaissance, building signals, and marking stations, for primary triangulation along the Rio Grande from the vicinity of Donna, Tex., to the Texas-California arc to the northward of Alpine, Tex.

The motor truck previously stored at Albuquerque, N. Mex., was driven overland to Harlingen, Tex. The chief of party traveled in the truck along the route to be followed by the triangulation and thus was able to learn of the character of the country and the sources of supplies. Other trucks and the outfit, which had been stored at



Needles, Cal., and Fort Smith, Ark., were shipped to Harlingen. At the close of the fiscal year the party was fully organized and equipped and ready to begin actual field work on July 1.

#### MICHIGAN.

[GEO. D. COWIE.]

**SUMMARY OF RESULTS.**—Precise leveling: 95 miles of levels run, 50 permanent bench marks established.

In May, 1917, work was begun on a line of precise leveling from Marquette to Escanaba, Mich. The line was completed to Escanaba on June 23, and the party proceeded to Algonac, Mich.

On June 27 work was begun on a line of levels from Algonac to the lower light on the St. Clair Flats Breakwater. This work was completed.

The work in Michigan was undertaken at the request of the United States Lake Survey.

The new leveling was connected with several old bench marks recovered at Marquette and Escanaba. No bench marks of the old leveling between those places could be found from field computations.

The line was about 85 miles long, and the elevations from field computations carried from Marquette are about 6 inches higher than the elevations at Escanaba for the old bench marks.

The work in the vicinity of Algonac, Mich., was done along the shore of the St. Clair River from Algonac to Point Aux Chenes; the line then crossed the North Channel on a 470-meter sight, then ran across Harsons Island and down the eastern shore as far as the Catholic Church, 1 mile south of Tasknoo Park.

From this place to Old Club the levels were run over very swampy ground crossed by about 40 small motor-boat canals. In this section of the work rowboats were used to carry the members of the party from place to place.

At Old Club another river crossing was made on a sight of about 300 meters to the St. Clair Flats Canal Breakwater, and the leveling was carried along the breakwater to Lower Lighthouse, checking on the established elevation of the bench mark there to within about 3 inches.

The time occupied in the work in Michigan was about one and a half months, and the total distance leveled over is about 95 miles.

#### INDIANA AND MICHIGAN.

[J. H. PETERS.]

**SUMMARY OF RESULTS.**—Precise leveling: 618.4 miles of levels run, 354 permanent bench marks established. (Note: The statistics for the portion of this work done between April 3 and June 30, 1916, were: 364 miles of levels run and 175 permanent bench marks established. The figures given in the summary of results in the abstract of this work in the Annual Report for 1916 are erroneous.)

On July 1, 1916, work was in progress on the line of precise leveling between Chicago, Ill., and Warsaw, Ind. This line, which is 118 miles in length, follows the main line of the Pennsylvania Railroad through the towns of Indiana Harbor, Gary, Valparaiso, and Plymouth.

After the completion of this line, the following links were added to the precise level net in the order given: Warsaw, Ind., to Jackson, Mich.; Mackinaw, Mich., to Jackson, Mich.; and Jackson, Mich., to Detroit, Mich. The combined length of these lines is 618.4 miles.

The season's work was completed on November 24, 1916.

The outfit of the party consisted of three motor velocipedes, two boxes of tools and repair parts, and the necessary instruments and stationery. This was the minimum with which the party could operate, and it was kept so as to facilitate rapid movement.

Many important changes were made in leveling methods during the season, which may be briefly enumerated as follows: Use of three motor velocipedes instead of two; recording observations with adding and listing machine; changes in field abstracts and computations; mounting the level on a motor velocipede; employment of professional trainmen as pilots for the cars; substituting flat-bottom rods with spike supports for the round-bottom rods with top of rail supports; use of rods that carry the graduations on gamma steel instead of those that carry the graduation on wood; use of three rods instead of two.

That the cost of leveling was lowered in this work in spite of increased cost of materials and labor, speaks well for the methods that were used.

The adoption of motor velocipedes for leveling operations has contributed more than any other single item toward the increased rate of progress and consequent lower unit cost now being obtained. The rate of progress of a party thus equipped depends in a large degree on having the car equipment in active condition.

A Barrett nine-bank calculating and listing machine was used for recording the rod readings and taking totals. All original notes except the descriptions of the bench marks were placed on this record.

Soon after the beginning of the 1916 season, a tripod was constructed by means of which the level could be set up on the motor velocipede, the observations being taken with the level thus mounted, the observer standing on the ground while making the readings. The results of the season indicate that the level thus mounted is more stable than it was before, that it holds its adjustment better, and that the work is less tiring on the observer. The round-bottom rods used in previous leveling were replaced by rods with a flat bottom. The heads of the track spikes were adopted as rod supports instead of the rails which had previously been in general use for this purpose.

A set of three gamma steel rods was received and used for about three weeks at the close of the season. The rods, as constructed, are well adapted to the field work.

The use of three rods instead of two was given a thorough trial and was found to possess several advantages as compared with the former method.

A notable feature of this season's work is the record made for rapidity of leveling in September, 1916, when 159.6 miles of double-leveled line were completed. There were run 340 miles of single line of levels. This record so far has never been equaled by any other party engaged on precise leveling in this or any other country. This record was made possible by the thoroughly efficient manner in which the chief of party organized and managed his party.

## NEW MEXICO AND TEXAS.

[O. W. FERGUSON.]

**SUMMARY OF RESULTS.**—Precise leveling: 276.2 miles of levels run, 170 permanent bench marks established.

Between September 16, 1916, and January 10, 1917, a line of precise levels was run between Clovis, N. Mex., and Pecos, Tex., following the lines of the Atchison, Topeka & Santa Fe Railway Co. between Clovis, N. Mex., and the State line and the Panhandle & Santa Fe Railroad between the State line and Pecos, Tex.

In this work certain improvements in methods and instruments recently adopted for work of this character were utilized. The precise leveling instrument was mounted on a motor car; an adding machine was used for recording and summing the back sights and fore sights; and the new form of invar level rod was used. During the first part of the work railroad spikes were used for turning points, and during the latter part of the work the top of the rail was used.

In every town and at other favorable places standard disk bench marks were set in substantial buildings, depots, and concrete walls, also many reinforced concrete posts with the disks in their tops were used as bench marks.

This line of levels was run in response to a request from the Director of the United States Geological Survey, for the purpose of furnishing precise elevations from which to extend lines of levels that were being run at the same time by parties of that survey for controlling topographic maps.

## ARKANSAS.

[J. S. BILBY.]

**SUMMARY OF RESULTS.**—Triangulation: Signal building, 3 signal poles erected, 27 tripod stands built, stations marked, and lines cleared, 3 observing tripods and scaffolds built, heights 50, 60, and 75 feet.

A building party was organized at Little Rock, Ark., July 1, 1916, for the purpose of preparing stations for the observing party along the Arkansas-Oklahoma arc of primary triangulation. The horses, wagons, and other property on storage at Osgood, Ind., and the motor truck and outfit stored at Nampa, Idaho, were shipped to Little Rock, Ark., and such of this property as was needed was used by the building party.

During the month of July signals were built at three stations 50, 60, and 75 feet in height, respectively, and stands were built at seven stations.

On August 1 the building party was turned over to the foreman, who continued the building of signals and marking of stations to the westward of Little Rock, while the chief of party made the necessary preparations for extending the reconnoissance from El Reno, Okla., to Needles, Cal.

From August 1 to October 31 twenty stations were prepared and made ready for the observing of angles. These stations were on hills

having small timber on top which required some clearing near the stations.

On October 31 the building party and outfit were transferred to E. H. Pagenhart, who at that time was in charge of the observing party.

[E. H. PAGENHART.]

**SUMMARY OF RESULTS.**—Primary triangulation: 1,500 square miles of area covered, 18 stations occupied for horizontal measures, 18 stations occupied for vertical measures, 20 geographic positions determined, 19 elevations determined trigonometrically.

Original instructions were issued May 10, and supplemental instructions June 20, 1916, for primary triangulation beginning at the western end of the Memphis-Little Rock traverse, which is near Little Rock, Ark., and extending westward to stations of the ninety-eighth meridian triangulation near Oklahoma City, Okla. It was to follow the reconnoissance executed in the winter of 1913-14. A connection was required with the Arkansas-Oklahoma boundary at monuments located between Hartford and Fort Smith, towns near the boundary.

The country between Little Rock and Fort Smith is hilly and timbered, and all except the few main roads are very poor. The observing party used two motor trucks for their transportation, one a three-quarter ton and the other one-half ton.

Closures of less than one second were obtained with 12 positions, and authority was given to use that number provided the closures remained below one second; this value was maintained. The average closure of the triangles formed by the 18 stations occupied was about 0.7 second.

On November 1 the building party which had previously been under the general charge of Signalman J. S. Bilby and under the immediate charge of Foreman William C. Nohl, was transferred to the chief of the observing party.

Building operations were discontinued on February 17, at which time the construction work had been completed from Little Rock westward to triangulation station Kanawa, Francis, and Sulzer, leaving only eight stations of the remainder of the scheme unprepared for occupancy.

The observing was discontinued on February 15 on account of bad weather and roads which tended to make the work much more expensive than when the weather and roads are good.

#### ARKANSAS AND TENNESSEE.

[E. H. PAGENHART.]

**SUMMARY OF RESULTS.**—Precise leveling: 132 miles of levels run, 125 permanent bench marks established, 2 primary azimuths observed.

On May 10, 1916, instructions were issued for a line of precise levels to be run in conjunction with primary traverse between Little Rock, Ark., and Memphis, Tenn. The field work of the traverse was completed June 30.

The line begins at Little Rock, where three old bench marks were connected with, and extends east to Dixie Mill, where it connects with northwest base, the westernmost point of the Memphis-Little Rock traverse. From that point it follows the traverse, which was along the Chicago, Rock Island & Pacific Railway, to Hopefield, which is just across the river from Memphis. The leveling there connects with triangulation station Hopefield, the easternmost point of the traverse. A spur line from bench mark B1 was run into Memphis, across the Mississippi River over the new Harrihan Bridge, and there a connection was made with previously established precise leveling bench marks.

The points on the railroad track where the tape ends fell during the traverse had their elevations determined, either as rod stations or as instrument stations. As the instrument was mounted on the car, and all stations on which no rod readings were taken were used as instrument stations, elevations of these points were accurately determined, as the height of instrument remained constant.

All of the traverse stations and their reference marks were used as bench marks, and had "B. M." stamped on them. Additional marks were set wherever the distance between traverse stations exceeded 4 miles, also in most of the towns. The railroad levels were connected with at various points along the line.

Leveling was begun on July 19 and was finished at Memphis on September 26. After preliminary computations were made and the outfit had been packed and shipped, the party returned to Argenta, Ark., on September 29. The computations of the elevations of the tape ends were finished on October 14.

From Little Rock to Forrest City a wagon road ran parallel to the track, and the dust from the road caused considerable delay in the work as sights had to be shortened to approximately 50 meters after 2 p. m.

Between October 15 and October 23 a party of three was engaged on making azimuth observations at the two stations DeValls and Forrest, of the traverse line.

#### ARKANSAS AND INDIANA.

[A. L. BALDWIN.]

During the last few days of the previous fiscal year, Mr. Baldwin proceeded from the office at Washington, D. C., to Little Rock, Ark., for the purpose of inspecting a party engaged on measuring a base at that place. The inspection was made during the early part of July of the fiscal year 1917.

The object of the inspection trip was to observe the behavior of the spring balance used for stretching the tape in the base measurement. As a result of Mr. Baldwin's inspection, slight modifications have been made in the spring balance with beneficial results.

Mr. Baldwin also inspected the precise leveling party which was operating in Indiana. He reported that the party was making excellent progress and that the innovations made in the method of mounting the instrument on the motor velocipedes and the recording of the rod readings on an adding machine, also mounted on the velocipedes, were most successful in enabling the work to be done more rapidly and at lower unit costs than formerly.

## OKLAHOMA AND NEW MEXICO.

[J. S. BILEY.]

**SUMMARY OF RESULTS.**—Reconnaissance: Length of scheme 975 miles, 29,000 square miles of area covered, 80 primary and 14 supplemental points selected for scheme. Base lines: 3 primary selected, lengths 14,300, 15,000, and 17,900 meters, respectively.

A party was organized for carrying on a reconnaissance for primary triangulation which would extend from El Reno, Okla., to the vicinity of Needles, Cal. The actual field work began at the eastern end of the arc on August 7.

The outfit used consisted of a motor truck with the usual camp equipment, tools, and instruments. Three stations, Carson, Kechi, and Lanier, of the ninety-eighth meridian triangulation, were recovered, and the line Carson-Kechi was used for the base from which to start the work, with Lanier for the third point. The work was extended westward and connected with primary triangulation stations in the vicinity of Needles, Cal.

In all 80 points for primary stations were selected for the main scheme, including 5 Laplace stations; 14 supplemental points were provided for; connection was made with six precise-level bench marks and 20 stations of the United States Geological Survey.

Connection was also made with the State boundary marks between Oklahoma and Texas and New Mexico. No marks were found on the boundary line between New Mexico and Arizona except a stone monument erected by the Atchison, Topeka & Santa Fe Railway Co. at a point where the railway is supposed to cross the State line. Two points were selected approximately on the State line to the south of the railway.

The actual field work was completed November 6 and the party moved to Albuquerque, N. Mex., where the outfit was stored and the party disbanded.

A one-half ton motor truck was used in this work. It was found that this truck will carry 1,200 pounds safely over any road practicable for travel with a motor truck, and the power was found to be sufficient under all conditions of roads.

The truck was driven to within a reasonable walking distance of all stations selected.

## CALIFORNIA.

[MAX STEINBERG.]

**SUMMARY OF RESULTS.**—Gravity determinations: 20 pendulum stations occupied.

Before beginning the field work, a standardization of the pendulums used in the field was made in June, 1916, in the pendulum room of the Coast and Geodetic-Survey office at Washington, D. C. After the completion of the field work on November 29, the instruments were returned to the office, and a restandardization of the pendulums was made in January, 1917.

The field season began at San Diego, Cal., July 11, 1916, but the actual observations were not begun until the 18th owing to delay in

the arrival of the instruments. Work was closed November 29. Twenty stations were completed during the season of 135 days, making the average time per station including Sundays and holidays  $6\frac{1}{2}$  days or  $5\frac{1}{2}$  working days.

The stations occupied were, as follows: San Diego, Oceanside, Highland, Pomona, Long Beach, Redondo Beach, Burbank, Palmdale, Mojave, Maricopa, Ventura, Conception, Vaila, San Lucas, Monterey, Hollister, Palo Alto, San Gregorio, Point Reyes, and Duncans Mills, all in California.

One latitude was determined by sextant observations at Palmdale, Cal.

During this season a slight modification of methods previously employed was made. Two pendulums were swung at each station instead of three, one for two days of 24 hours each and the other for one day. The period of each individual swing was also increased from 8 to 12 hours. Another change was to place the second pendulum inside the receiver in order to attain the temperature of the receiver while the first pendulum was swinging.

Western Union time signals from the Mare Island Naval Observatory were used through the season.

The mean probable error of observed gravity was 0.0008 dyne.

The results of the restandardization of the pendulums in January, 1917, showed a slight increase in the periods of all the pendulums over the values obtained in June, 1916.

[E. B. LATHAM.]

In the latter part of February a determination was made by triangulation of the geographic positions of two radio stations, one near Avalon and the other near Inglewood, Cal.

The radio station at Los Angeles, Cal., was visited for the purpose of identifying and describing it.

The city engineer of Los Angeles was consulted in regard to the triangulation being done by him. Station West Beach 2, city of Los Angeles, was occupied by the Coast and Geodetic Survey observer when determining the geographic position of a radio station.

An arrangement was made by which the Coast and Geodetic Survey may obtain without charge copies of the results and descriptions of stations of the city triangulation.

[E. W. EICKELBERG.]

**SUMMARY OF RESULTS.**—Triangulation: 144 square miles of area covered, 25 stations recovered and re-marked, 20 signal poles erected, 23 stations in main scheme occupied for horizontal measures, 5 stations occupied for vertical measures, 65 geographic positions determined, 5 elevations determined trigonometrically. Leveling: 1 permanent bench mark established,  $2\frac{1}{2}$  miles run.

In November a party was organized to furnish the necessary control for the hydrography and topography of San Francisco Bay for the party engaged in wire-drag work; to locate any objects of value as aids to navigation; to recover the old triangulation stations in the vicinity of San Francisco Bay; wherever necessary to re-mark these stations; to determine the elevation of the ground at four radio stations; to determine the geographic position of two of these stations; and to make a report on lost intersection triangulation stations located in previous years.

A launch was hired for the transportation of the party, and after the necessary preliminary arrangements had been made, signals were erected in the locality in which the first work with the wire drag was to be done, and the stations visited were re-marked. In this work the usual methods for tertiary triangulation were adhered to.

The area over which the party operated is 144 square miles, and the linear length of the region is 32 miles. An effort was made to meet the requirements of the wire-drag work at the Golden Gate. However, on account of difficulties with the ground wire, drag work had to be given up, and instead sounding lines one-half mile apart were run over the entire area from Brothers Lighthouse to Point Avisadero. The triangulation could not keep ahead of this work, which was completed in a short time, but the signals used by the sounding party were afterwards located and positions thus furnished for the finished hydrographic sheets.

Prominent objects and aids to navigation were located as reported in a special report to the Superintendent.

The recovery and re-marking of the old triangulation stations was attended with some difficulty. In many cases the surface mark had been destroyed or grown over with sod. In some cases there were no surface marks in the original marking of the station. Some underground marks of old stations were found after new stations had been located near them.

Out of a total of 63 triangulation stations searched for only 24 were recovered.

The points in the northern end of San Francisco Bay were more readily recovered than those in the southern end of the bay, owing to better marking of the station.

Stations recovered were carefully marked and reference marks were placed.

The elevations at the foot of the wireless towers were obtained directly by leveling.

At the request of the inspector in charge of the San Francisco suboffice, the accuracy of the resetting of the Presidio tide staff was investigated and found to be very slightly in error. Only two bench marks were in existence of the original five, and a new bench mark was therefore set and its elevation determined by leveling.

Field work was closed March 13.

#### UTAH, OREGON, NEVADA, AND CALIFORNIA.

[C. V. HODGSON.]

**SUMMARY OF RESULTS.**—Primary triangulation: 7,720 square miles of area covered, 13 observing stands built and stations marked, 20 stations in main scheme occupied for horizontal measures, 8 stations in supplemental schemes occupied for horizontal measures, 30 stations occupied for vertical measures, 42 geographic positions determined, 37 elevations determined trigonometrically, length of scheme 300 miles. Latitude, longitude, and azimuth work: 4 azimuth stations occupied.

Observations of angles in the primary triangulation along the Utah-Oregon arc were resumed at Stanfield, Oreg., May 10, 1916, and were in progress at the beginning of the fiscal year. The work done to July 1, 1916, is detailed in the last annual report.

By the end of June, 1916, 10 stations had been occupied. The last five of these stations were in the Cascade Mountains where the



snow from the previous winter, said to have been the heaviest in 30 years, still lay several feet deep on the upper slopes. This condition not only delayed progress in moving but was also the cause of the peaks being cloud-capped to a degree not usually found at that season of the year.

The occupation of the station Larch completed the connection between the Stanfield base and the California-Oregon arc of primary triangulation. The light keepers were then sent to stations east of Stanfield, Oreg., in preparation for the work on that portion of the arc between the base at that place and the work done during the previous season in southwestern Idaho. The observing party stopped long enough on the way to Stanfield to make the reconnoissance and observations for a connection with the triangulation of the United States Engineers along the Columbia River at Celilo, Oreg. Stanfield was reached by the chief of party August 6, and observations were begun on the arc to the eastward.

There were 14 stations on this portion of the arc. Of these 5 were reached by long packs, and 2 were located by the observing party after it was found that the line Fanny-Iron was obstructed. The observations on the Utah-Oregon arc were completed on September 15.

On September 15 the party was assembled at Nampa, Idaho, to prepare for triangulation from the thirty-ninth parallel in Utah to the Texas-California arc in the vicinity of Needles, Cal.

On September 23 the first of the light keepers were started for their stations, and on the 25th the observing party began traveling by automobile trucks toward its first station 225 miles away. It reached the foot of the mountain on which the station was located, on the 27th. The foot of the last steep slope below the station was reached on the afternoon of the second day following after a hard 18-mile pack. Camp was made and the observing outfit back packed the remaining mile to the station.

It was impossible to get observations on the first night owing to the failure of the light keepers to get their signal lamps in working order. The following night the weather became unfavorable with sleet, snow, and high winds. These conditions continued until the night of October 2, when the lack of wood and shelter on the high slope of the mountain compelled the party to move down about 3,000 feet into a canyon, where the ruins of a cabin and abundant fuel provided better means for protection against the severe weather. On the 5th it stopped snowing, and a fresh supply of provisions was back packed to the top of the mountain. Four hours were spent digging out of the snow the observing outfit and camp equipment, but the party was driven down again by a fresh snowfall. The snow was then so deep that it was dangerous to keep light keepers on their exposed stations, and authority was obtained from the office to suspend operations. In removing the observing outfit from Tushar, the snow was found to be so deep that the outfit had to be hauled on hand sleds for 3 miles to where it could be reached by pack animals.

The party was disbanded on October 14, except those who were needed on the reconnoissance that the chief of party was directed to make in Nevada and California. During the season in Oregon and Idaho, the chief of the Coast and Geodetic Survey party cooperated with the local officials of the Forest Service in the determination

of the geographic positions of 13 stations located within the forest reserves that were needed for observation towers and lookout stations in the work of that service.

#### CALIFORNIA, OREGON, AND WASHINGTON.

[C. L. GARNER.]

**SUMMARY OF RESULTS.**—Gravity observations: 20 stations established. Triangulation: 1.5 square miles of area covered, 10 signal poles erected, 15 geographic positions determined.

During the period between July 18 and November 29, 1916, the determinations of the intensity of the force of gravity were made at a number of stations on the Pacific coast.

The locality of the work was in the States of Washington, Oregon, and California, following the Pacific coast at a distance never more than 100 miles from the ocean.

There were 20 stations established. They were at the following places: In Washington, Bellingham, Everett, Issaquah, Port Angeles, Port Townsend, Port Gamble, Bremerton, Tacoma, and Moclips; in Oregon, Portland, Tillamook, Newport, Eugene, Marshfield, and Glendale; in California, Sacramento, Willits, Eureka, and Santa Rosa.

At all of these stations very satisfactory conditions were found for the work. No piers for the support of the pendulum receiver had to be constructed, and no changes in the buildings or rooms for the control of the temperature were necessary. A convenient telegraph line was found at each station, and it was never necessary to receive time signals by telephone.

During the course of the gravity work, a determination of the position of the towers of the Navy radio station at Marshfield, Oreg., was made. This was done at intervals between gravity observations without impeding the progress of the party.

In January, 1917, after the return to Washington, a restandardization of the pendulums was made with the result that the mean periods of the pendulum were seven less (seventh place of period) than the previous standardization in July, 1916.

The noon signals sent out from the Mare Island Naval Observatory over the telegraph lines were used for rating the chronometers used in determining the times of swinging of the pendulums.

The usual interest in the work was shown by the public, and on several occasions articles concerning the work appeared in the press. These were in accordance with the general policy of the Survey. After the first few weeks of the season, a multigraphed statement briefly outlining the purposes of the work was ready for distribution and was given out to newspapers and people interested.

#### WASHINGTON, OREGON, CALIFORNIA, NEVADA, IDAHO, AND UTAH.

[W. B. FAIRFIELD AND J. E. McGRATH.]

**SUMMARY OF RESULTS.**—Latitude and longitude: 6 primary latitude stations established, 8 longitude differences (telegraphic) determined, signals exchanged on 28 nights.

During the period between July 15 and December 18, 1916, differences of longitude were determined between Walla Walla, Wash.,

and Echo Oreg.; Echo and La Grande, Oreg.; La Grande, Oreg., and Mountain Home, Idaho; Mountain Home and Blackfoot, Idaho; Blackfoot, Idaho, and Salt Lake City, Utah; Salt Lake City and Lund, Utah; Lund, Utah, and Moapa, Nev.; and Moapa, Nev., and Needles, Cal.

The first complete set of observations was made at Echo, Oreg., and exchange of signals had with Walla Walla, Wash., on July 31; also on August 1 and 2 others completing the line Walla Walla and Echo.

On August 15, 19, 20, and 21, observations were made and exchange of signals had between Echo and La Grande stations, Oreg., completing the line Echo and La Grande. Observations for the determination of the latitude of Echo station were made on August 22 on 15 pairs of stars.

Observations were made and exchange of signals had between Mountain Home, Oreg., and La Grande station on September 1, 5, and 6, completing the line La Grande and Mountain Home. The latitude of La Grande was determined by observations on August 29, 30 and 31. On September 11 observations were made on 19 pairs of stars for the determination of the latitude of Mountain Home station.

On September 20, 21, and 24, observations were made and exchange of signals had between Mountain Home and Blackfoot, Idaho, completing the line Mountain Home and Blackfoot. The latitude of Blackfoot, Idaho, was determined by observations on October 6 and 9.

Observations were made and exchange of signals had between Salt Lake City and Blackfoot, Idaho, on October 16, 18, 19, and 20, completing the line Blackfoot and Salt Lake City.

Observations were made and exchange of signals had between Salt Lake City and Lund, Utah, on November 2, 3, and 9, completing the line Salt Lake City and Lund. The latitude of Lund was determined by observations made on November 21.

On November 27, 28, and 29, observations were made and exchange of signals had between Moapa, Nev., and Lund, Utah, completing the line Lund and Moapa.

On December 6 observations were made on 24 pairs of stars for the determination of the latitude of Moapa station.

On December 12, 13, and 14, observations were made and exchange of signals had between Moapa and Needles, Cal., completing the line Moapa and Needles, Cal., and also completing the program laid out for the season's work.

Bamberg transits Nos. 20 and 21 were used in making all of the observations in connection with chronographs of the type generally used in the Survey.

The Western Union Telegraph Co. cooperated in the work, making all of the connections promptly as required and furnishing operators at night when needed.

Observations for latitude were made at Echo and La Grande, Oreg., Mountain Home and Blackfoot, Idaho, Moapa, Nev., and Lund, Utah.

At Walla Walla, Wash., and Needles, Cal., new astronomical stations were established which were referred to the old stations.

## WASHINGTON.

[J. F. PRATT.]

On April 28 the positions of two radio towers at the United States Naval Torpedo Station at Keyport, Wash., were determined by triangulation.

These two steel open lattice towers, on permanent foundations, are very high, the northerly one being on lower ground than the southerly one, their tops being approximately the same height above the sea level.

This determination was made from stations of a triangulation made by the wire-drag party under charge of J. A. Daniels executed late in 1915 and early in 1917.

[J. F. PRATT.]

**SUMMARY OF RESULTS.**—Triangulation: 1 signal built, 4 stations occupied for horizontal measures, 15 geographic positions determined.

In February, 1917, a determination was made by triangulation of the geographic positions of a number of wireless telegraph stations in Seattle, Wash.

For this work the stations used had been determined by previous triangulation.

## MAGNETIC WORK.

## MAINE, NEW HAMPSHIRE, NEW YORK, AND VERMONT.

[FRANKLIN L. ADAMS.]

**STATIONS OCCUPIED.**—Maine: Dover, Fort Kent, Houlton,\* Millinocket, Skowhegan, South Paris, and Van Buren. New Hampshire: Chesterfield, Hanover,\* Lancaster, and Orford. New York: Dannemora, De Ruyter, Faust, Inman, Ithaca, Ovid, Fort Kent, and Wampsville. Vermont: Chelsea, Newport, and Richford.

Observations of the three magnetic elements were made at the stations above named between July 1 and August 28.

Of these stations, two marked by asterisks (\*) were exactly re-occupied. Stations were occupied at Dannemora and Ithaca within a short distance of the sites of the old stations the marks of which had been destroyed.

The conditions at Dannemora were much disturbed, the station being within a short distance of the abandoned workings of an iron mine.

A new station was established at Ithaca about half a mile distant from the site of the old one.

At Chesterfield a new station was established and a meridian line laid out on the village green 5 miles distant from the old station.

The regions about Richford, Inman, and Faust were found to be strongly disturbed locally and were partially explored. Seven auxiliary stations were made about Richford. Two stations less than 5 miles apart were found to differ more than  $9^{\circ} 25'$  in declination.

## MARYLAND.

## CHELTENHAM MAGNETIC OBSERVATORY.

[GEORGE HARTNELL.]

The regular work of the Cheltenham Magnetic Observatory was continued during the year, including the operation of two magnetographs and a seismograph, observations with the standard observatory instruments and also comparison of the field instruments with observatory standards, the computation of all base lines, as well as of the absolute observations, the hourly scalings of the magnetograms and reports of earthquakes, and all other necessary work connected with the foregoing.

All of the observatory instruments have been in satisfactory operation during the year. Some repairs made to the instruments resulted in an improvement in the record. Considerable attention has been given to the subject of earth inductors both theoretically and experimentally.

Necessary repairs to the observatory buildings were made.

During the year 28 earthquakes were recorded.

## FLORIDA, GEORGIA, AND SOUTH CAROLINA.

[J. R. BENTON.]

STATIONS OCCUPIED.—Florida: Cross City, Gainesville,\* and Newberry. Georgia: Savannah\* and Waycross.\* South Carolina: Barnwell, Columbia, and Sally.

Between June 6 and June 30, 1917, complete magnetic observations were made at the stations named.

Old stations were reoccupied at the places marked by asterisks (\*).

At the other places on the list new stations were occupied. No permanent marks were left at these stations except at Sally.

At Barnwell auxiliary stations were occupied to determine the extent of the magnetic disturbance. Eight such points were occupied at distances of about 5 to 10 miles from Barnwell to the east, south, west, and north.

ALABAMA, ARKANSAS, KANSAS, MISSISSIPPI, MISSOURI, OKLAHOMA,  
AND TENNESSEE.

[WALLACE M. HILL.]

\* STATIONS OCCUPIED.—Alabama: Huntsville.\* Arkansas: Booneville, Greenwood, Tyronza, and Yellville.\* Kansas: Anthony, Cimarron,\* Copeland, Johnson, New Ulysses, Salina,\* and Santa Fe. Mississippi: Corinth.\* Missouri: Alton, Forsyth, Gainesville, and Thayer. Oklahoma: Jay, Vineta, and Stillwell. Tennessee: Athens,\* Knoxville,\* and Memphis.\*

Observations of the three magnetic elements were made at the above-named stations between March 17 and June 30, 1917.

Old stations were reoccupied at the places marked by asterisks (\*).

Meridian lines were laid out at Alton, Jay, and Santa Fe.

Observations were made at auxiliary stations in the vicinity of Yellville, Forsyth, Anthony, and Cimarron.

#### ARKANSAS, INDIANA, AND MISSOURI.

[WALLACE M. HILL.]

**STATIONS OCCUPIED.**—Arkansas: Des Arc, Little Rock,\* and Piggott. Indiana: Indianapolis.\* Missouri: Bloomfield,\* Boonville, Buffalo, California, Carrollton, Columbia, Fulton, Hermitage,† Huntsville, Jefferson City,† Kansas City,\* Kennett,† Linn, Linn Creek, Marshall,†\* Mexico,\* Montgomery City, Poplar Bluff, Potosi, Stockton, Tuscumbia, Union, University City, Versailles, Vienna, Warrenton,† and Warsaw.

Observations of the three magnetic elements were made at the stations named during the period from July 1 to Nov. 16, 1916. Old stations were reoccupied at places marked by an asterisk (\*). Meridian lines were established at stations marked by a dagger (†). Nine auxiliary stations to test local magnetic disturbances were occupied near Bloomfield and eight near Linn Creek.

#### CALIFORNIA.

[W. W. MERRYMON.]

**STATIONS OCCUPIED.**—California: Cooperstown, Downie, Galt, Goat Island, Jackson, Mariposa, Martinez, Quincy, San Andreas, and Sonora.

Between August 1 and September 16 determinations of the three magnetic elements were made at the stations named.

The old station on Goat Island was found and reoccupied.

#### COLORADO, IDAHO, NEW MEXICO, OREGON, TEXAS, UTAH, AND WASHINGTON.

[H. E. McComb.]

**STATIONS OCCUPIED.**—Colorado: De Beque, Durango,\* Fort Garland, Grand Junction,\* Paonia, Rifle, San Luis, Tercio, and Trinidad.\* Idaho: Preston. New Mexico: Aztec, Endee, Milla, Mora, Mosquero, Shiprock, Springer, Tierra Amarilla, Tucumcari,\* and Ute Park. Oregon: Brogan, Enterprise, Homestead, Huntington, Juntura, La Grande, Ontario, Pendleton,\* and Vale. Texas: Amarillo.\* Utah: Green River\* and Ogden.\* Washington: Connell, Davenport, Ephrata, Okanogan, Pasco, Republic, Spokane,\* Springdale, and Wilbur.

Between March 19 and June 30, 1917, complete magnetic observations were made at the places named.

Four auxiliary stations were established at each of the following stations: Mills, Springers, Trinidad and Wilbur.

Old stations were reoccupied at the places marked by asterisks (\*).

A meridian line was established at Ephrata at the request of local surveyors.

Local surveyors and engineers manifested great interest in the work in Oregon and Washington and requested copies of observations made in their localities and other available information on the subject.

## IDAHO, MONTANA, NORTH DAKOTA, SOUTH DAKOTA, WASHINGTON, AND WYOMING.

[H. E. McCOMB.]

**STATIONS OCCUPIED.**—Idaho: Albion, American Falls, Caldwell, Coeur d'Alene, Driggs, Emmet, Gooding, McCall, Moscow, Nez Perce, Orofino, Pocatello,\* Pollock, Rexburg, Rigby, Rupert, St. Maries, Silver City, Smiths Ferry, Twin Falls and Wallace. Montana: Baker, Browning,\* Columbus, Ekalaka, Glendive, Libby, Livingston,\* Sidney, Sweetgrass,\* Virginia City, Whitehall, Wibaux, Yellowstone, and international boundary monuments Nos. 276, 281, 295, 315, and 350. North Dakota: Amidon, Beach, Bowman, Fort Yates, Leith, Mott, Shields. South Dakota: Dupre, Huron,\* Laplant, McLaughlin, and Mound City. Washington: Newport. Wyoming: Yellowstone Park.

Old stations were reoccupied at the places marked by asterisks (\*).

Observations of the three magnetic elements were made at the stations listed above during the period from July 1 to November 4, 1916.

The stations on the international boundary were first occupied. These were not permanently marked. The remaining stations were usually marked by concrete posts, excepting Smiths Ferry, Idaho; Baker, Whitehall, and Yellowstone, Mont.; Leith and Shields, N. Dak.; McLaughlin, S. Dak.; and Yellowstone Park, Wyo.

## ARIZONA.

## TUCSON MAGNETIC OBSERVATORY.

[FRANKLIN P. ULRICH.]

At the magnetic observatory near Tucson, Ariz., the magnetograph was in continuous operation recording variations in declination and horizontal and vertical intensities. Absolute observations were made as previously and time corrections were obtained as usual at least once a week from the Mare Island time signals.

The Bosch-Omori seismograph was kept in continuous operation and 37 earthquakes were recorded. The periods of the pendulums remained unchanged.

Daily meteorological observations were obtained and reported to the local office of the Weather Bureau until October 9 when the Weather Bureau removed all of its instruments. After that date the temperature and weather conditions and amount of rainfall were recorded.

## ILLINOIS.

[WM. W. MERRYMON.]

**STATIONS OCCUPIED.**—Illinois: Hoopeston, Saybrook, and Urbana.

Between June 21 and June 30, 1917, the three magnetic elements were determined at the places named, of which Hoopeston and Saybrook were new stations.

## ALASKA.

[JOHN A. DANIELS.]

**SUMMARY OF RESULTS.**—Reconnaissance: Length of scheme 16 miles, 49 square miles of area covered, 27 lines of intervisibility determined, 14 points selected for scheme. Triangulation: 85 square miles of area covered, 17 signal poles erected, 14 observing tripods and scaffolds built, 28 stations in main scheme occupied for horizontal measures, 34 geographic positions determined. Leveling: 4 permanent bench marks established, 3.1 miles of levels run. Topography: 92 miles of general coast line run, 4 topographic sheets finished. Hydrography: 139.4 miles of area dragged, 282.17 miles run while dragging, 1,714 positions determined (double angles), 62 soundings made, 1 tide station established, 8 hydrographic sheets finished, scales 1: 40,000 and 1: 20,000.

During the season of 1916 the scheme of secondary triangulation executed by this party in 1915 and terminating in the line Stick-East, was extended in a primary scheme to Dry Strait, terminating on the line Ryn-Kad, situated on Rynda and Kadin Islands, respectively. The triangulation covers a distance of 23 statute miles and comprises 22 occupied stations and 40 closed triangles. The average triangle closure obtained was 0.88 second.

From the line Duck-Gray of the above scheme tertiary work was carried into Zimovia Strait, connecting with the work of 1886 and 1893 in the vicinity of Wrangell. In the tertiary scheme the signals were nearly all built by the party on the steamer *Patterson* and the observing done by the wire-drag party. The tertiary scheme connects with the work of the *Patterson* in Zimovia Strait, and the primary scheme connects with the work of wire-drag party No. 4 at Wedge Point and Five Mile Island. The tertiary scheme extends for a distance of 18 statute miles and covers an area of 46 square miles. It includes 15 occupied stations and 25 closed triangles with an average closure of 4.07 seconds.

The character of Round Point, the point of Zarembo Island at the bend in Stikine Strait near Stikine Lighthouse, a sheer round point with no projections visible from either side, made necessary the insertion of an extra quadrilateral with corresponding signal building and observing. South Craig Point presented similar difficulties. In other cases little difficulty was experienced in obtaining lines of fair length and figures of sufficient strength.

In connection with the scheme the base on the east shore of Zarembo Island was measured in the months of August and September, and the observing in connection with the broken base was done with the direction instrument. The base work comprised seven stations, besides the occupation of stations Kof and Tole to tie the base to the main scheme. The topography of the shore line outlined in the plans for the season's work was completed with the exception of that from Caamano Point on Cleveland Peninsula to a point about  $4\frac{1}{2}$  miles southward from Lemesurier Point. The completed work extends northward from this point and includes the irregular shore line in the vicinity of Lemesurier Point.

On the western shore of Clarence Strait the shore line of Prince of Wales Island was completed from Tolstoi Island to Coffman



Island including Ratz Harbor and Coffman Cove. No contouring was done along this shore.

The southern half of Zarembo Island was surveyed but no contours were run. Both the shore line and contours of Woronkofski Island were completed.

In the hydrography all areas were dragged to an effective depth of 50 feet where such depths existed, and all soundings of less depth were verified within the area surveyed, provided such soundings were located within the probable path of navigation.

In general the drag was taken within about one-fourth mile of shore, except in bays where the distance from shore was sometimes greater and at headlands where it was less. At headlands or islands that are likely to be used by navigators as turning points in a vessel's course, particular care was exercised to pass the drag as closely as possible to shore. Signals for the control of this work were located by triangulation, except in Chichagof Pass where they were determined by planetable.

The dragging of Clarence Strait was completed by first covering the small areas left in 1915 to the southward of Lemesurier Point and then working systematically to the northward covering all unswept areas. Good progress was made in the open sections. The work was taken into Rocky Bay where several important dangers were discovered. Ratz Harbor was dragged and sounded and found to be clear as charted. Five important dangers were found in Clarence Strait.

The open area of Ernest Sound was dragged from Lemesurier Point to Point Peters, and six important dangers were found. Upon the southern shore the drag was carried into Union Bay and into Vixen Inlet as far as Sunshine Island. Upon this side of the sound the shore was closely followed throughout, while upon the northern side the numerous outlying rocks and islands prevented a near approach to the shore line without considerable inshore work. As no inshore hydrography was available for control this inshore dragging was not done.

The dragged area of Stikine Strait extends from a junction with that at Steamer Point in Clarence Strait to a line from Wedge Point to South Craig Point, connecting here with the work of wire-drag party No. 4. Although generally clear, this proved to be a difficult area to cover on account of particularly strong and erratic tidal currents. Whirls, eddies, cross currents, and undertows made it almost impossible to use a long drag without parting it, and it was practically impossible to determine from the predicted tides in which direction the flow would be at a particular time in any locality. Stikine Strait was found clear except close to shore where two pinacles dangerous to small boats were found. The shore line was very closely approached in this locality.

All of the apparently clear area in the southern part of Kashevarof Passage as far north as West Island was dragged, also the two principal approaches to Lake Bay cannery. Numerous shoals, several of which are dangerous, were found, and these in conjunction with the strong tides made this a troublesome area to drag. The work

in the approach to the cannery, where four dangers were found, was done when the weather did not permit work to be done outside. Short drag work only was done in this locality. The northern part of Kashevarof Passage as far south as Fire Island was dragged, leaving only the narrows between Fire Island and West Island undragged. This northern area was done in conjunction with Snow Passage and the part of Clarence Strait between Snow Passage and Point Colpoys. The locality abounds in islands and shoals, which with the tidal current of from 3 to 6 knots made the drag work extremely difficult. Much time and material were expended with but little apparent result. However, the conditions that interfere with drag work make this a very dangerous locality for navigation, and renders it all the more necessary that the shoals should be correctly charted. Six dangers were located in Kashevarof Passage. The area was well covered and all shoals fully developed.

The area in Chichagof Pass was covered and no dangers were found. Zimovia Strait was dragged from a point 1 mile southward from Young Rock to Olive Cove. Anita Bay was not dragged and only the open water northward from Olive Cove was covered.

#### NEW WIRE-DRAW EQUIPMENT.

Ground wire of galvanized seven-strand extra strength cable three-sixteenths of an inch in diameter, made into 100-foot sections and joined by means of one-fourth inch drop-forged swivels and special light sockets, was used for the first time and proved a success. It is much more satisfactory than the No. 7 telephone wire formerly used, although it was frequently parted when grounded in the strong tides of Snow and Kashevarof Passages.

The newly designed small buoy, which is nun shaped and larger and heavier than those formerly used, was satisfactory, as it caused the entire elimination of loss due to the collapse on account of water pressure when towed under. This has been a serious hindrance in former seasons in Alaska, and its disappearance is very gratifying. The new buoy is heavier and harder to handle than the others, but upon the whole is more suitable.

During this season metal floats instead of wooden ones were regularly used for the first time in wire-draw work. They are constructed of No. 18 galvanized sheet metal, riveted and soldered so as to be water-tight. The float is cylindrical in shape, with a cone at one end, at the apex of which a ring bolt is inserted and heavily soldered for attaching to the ground wire by means of a short line and snap-hook. In order to provide sufficient buoyancy to support a 100-foot section of the ground wire, this make of float must be of a size to occupy about the same space as the old style wooden float. The great advantage over the wooden float is the constant buoyancy, as one of the most troublesome uncertainties connected with wire-draw work in the past has been the varying buoyancy of the wooden floats due to waterlogging. At a cost of about \$1.80 each, these floats are a great improvement.

[L. O. COLBERT.]

**SUMMARY OF RESULTS.**—Triangulation: 372 square miles of area covered, 105 signal poles erected, 22 stations in main scheme occupied for horizontal measures, 90 stations in supplemental schemes occupied for horizontal measures, 10 stations occupied for vertical measures, 121 geographic positions determined, 10 elevations determined trigonometrically. Leveling: 9 permanent bench marks established. Topography: 381 square miles of area surveyed, 242 miles of general coast line surveyed, 23 miles of shore line of creeks surveyed, 7 topographic sheets finished, scale, 1:20,000. Hydrography: 277 square miles of area dragged, 593 miles run while dragging, 51 miles run while sounding, 21,255 angles observed, 157 retained soundings, 3 tide stations established, 6 current stations occupied, 10 hydrographic sheets finished, scales, one 1:10,000, nine 1:20,000.

Wire-drag party No. 4 began field work in southeastern Alaska April 19 and closed October 14, 1916.

The work done before July 1 is detailed in the annual report for the last fiscal year.

The completed survey consists principally of a wire-drag examination of the areas hereafter described. To control this survey a scheme of triangulation was carried forward. At the same time a topographic revision of the shore line was conducted. The wire-drag survey was supplemented by soundings in certain sections and by tidal and current observations.

The work of the season was in two localities, the first at the entrance to Sumner Strait in the vicinity of Cape Decision and the second at the eastern end of Sumner Strait and the channels adjoining and extending to the eastward from it.

At the entrance to Sumner Strait a complete wire-drag survey was made within the following limits: Beginning in the vicinity of Calder Rocks an area of about 5 miles was covered in mid-channel between the inshore limits of the previous season's work. To the westward of Bluff Island one day's work covered a detached area of about 3 square miles. On the northwestern side of the strait from Cape Decision to the southern limits of the work of the previous season an inshore strip averaging about  $1\frac{1}{4}$  miles wide was dragged. The inshore edge of this area is bounded by charted reefs and small islands between which no attempt was made to carry the drag. This latter strip covers an important area to the eastward of numerous reefs and small islands, which lie along the shore of Kuiu Island. It embraces the usual ship track for steamers bound around Cape Decision, which course is taken by many of the larger steamers to avoid Wrangell Strait. It was considered the most important portion of the area to be surveyed, and most of the time allotted was spent in this section instead of in the deeper waters offshore.

The drag was set at an effective depth of 48 feet where the chart did not show less water. In the vicinity of shoals the drag was set at about 2 feet less than the depth over the shoals.

In this section six shoals were found.

An automatic tide gauge was established at Pole Anchorage before commencing drag work. The records of the automatic gauge at Wrangell were used for comparison.

No special current observations were made during the progress of this work, but during the drag work certain facts in regard to the currents were noted.

Information in regard to harbors on this portion of the coast was collected for use in the coast pilot.

A topographic survey was made of the shore line of Kuiu Island from the vicinity of Amelius Islands to Point St. Albans, including also the Diomed Islands and the stretch from Port McArthur to Cape Decision. This survey was made to give an accurate location of the numerous off-lying islets and reefs along this important coast. On account of poor weather conditions during the work and later on account of lack of time, less attention was paid to the contouring than to the delineation of the shore line.

Three recovered stations of the triangulation of 1886 in the vicinity of Shakan Bay were connected by secondary triangulation with three recovered stations located by E. F. Dickins in 1889. This scheme covered the area in which the work of the season was done and was the basis of control for those surveys. The locations and heights of all prominent mountain peaks in this general vicinity were determined.

In the eastern part of Sumner Strait and adjoining channels to the eastward, wire-drag work was taken up from the limits of the work of the previous season in the vicinity of the Eye Opener. A junction was made with the work of wire-drag party No. 3 on a line joining Point Colpoys and McNamara Point. The area south of this line was dragged by party No. 3.

After dipping into the entrance to Duncan Canal and into Wrangell Strait as far as Deception Point the drag was carried through the remaining waters of Sumner Strait. In Stikine Strait a junction was made with the work of wire-drag party No. 3 on a line joining South Craig and High Points. In Zimovia Strait the junction was about 3 miles south of Young Rock. The drag was run close to the southern edge of the flats at the mouth of the Stikine River.

All of Eastern Passage and Blake Channel was dragged with the exception of the small bay north of Point Madan and that part of Bradfield Canal east of Anan Bay. Instead of dragging these waters the time was spent in extending the work to the southward through Ernest Sound to form a junction with the work carried into this body of water from the south by wire-drag party No. 3. In Ernest Sound the main channel only was dragged.

The standard depth to which all deep water was dragged was 48 feet, except close inshore or where the chart showed a less depth. All sunken rocks and shoals located were dragged over with about 2 feet less than the least depth found.

In this section of the season's work there were found 17 uncharted shoals.

Lines of soundings were run across the edge of the flats off the mouth of the Stikine River to determine the present limits of these flats. These lines were run normal to the general trend of the edge of the flats and the system was carried from the Wilson Islands to Gerard Point. Lines of soundings were also run in the vicinity of Rock Point and Point Highfield.

At the head of Blake Channel soundings were also taken to define the limits of the extensive flats off Aaron Creek.

Tides were recorded with an automatic tide gauge at St. John Harbor from April 22 to May 2 and from June 20 to September 26. During this period automatic gauges were in operation in Wrangell Harbor and Lake Bay. A tide staff was erected at Ham Island in

Blake Channel, and tides were observed simultaneously with observations on the gauge at Wrangell.

Observations were made for the direction and velocity of the tidal current at six stations.

The schooner *King and Winge* was used at the principal stations, anchoring in deep water.

The coast pilot information for the localities surveyed was verified, and additional details in regard to these channels were noted in the descriptive reports.

A 10-fathom bank was found in the eastern end of Sumner Strait about mid-channel between Vank and Zarembo Islands and two shoals, one at each end of the passage between Vank and Sokolof Islands. The one in the approach to the western end is the more dangerous, having about 12 feet of water over it. The other has about 27 feet of water over it.

With the exception of these shoals, Eastern Passage and Blake Channel were found free of dangers. The use of these passages by vessels bound for Wrangell should be more general when it is known that no hidden dangers exist. Special mention should be made of the fact that heavy seas in Clarence Strait due to southeasterly gales may be avoided by this route.

No dangers were found in Bradfield Canal or in Ernest Sound where dragged except one off the north end of Deer Island.

Topographic surveys of the shore line of Sumner Strait were begun at McNamara Point on Zarembo Island and at Point Alexander on Mitkof Island and were completed to the eastward including all the islands lying in this end of the strait. The heights and contours of the hills and ridges visible from the strait were determined. These surveys were carried through Eastern Passage and Blake Channel into Bradfield Canal as far as the junction of the latter with Ernest Sound.

A scheme of secondary triangulation was continued from Mitchell Point and Point Colpoys, to which line it had been carried in 1915, to a junction with the primary scheme by John A. Daniels in Stikine Strait. The control of the topographic and wire-drag sheets was based on this work. For the control of surveys in Eastern Passage and Blake Channel triangulation of a tertiary character was observed starting from stations established by O. H. Tittmann at the mouth of Stikine River. In Bradfield Canal the work was joined to bases obtained from C. G. Quillian, who carried the triangulation through Ernest Sound from Clarence Strait.

[L. O. COLBERT.]

**SUMMARY OF RESULTS.**—Triangulation: 24 square miles of area surveyed, 31 signal poles erected, 6 stations in supplemental schemes occupied for horizontal measures, 8 geographic positions determined. Levelling: 3 permanent bench marks established. Topography: 37 square miles of area surveyed, 72 miles of general const line surveyed, 1 topographic sheet finished, scale 1:20,000. Hydrography: 48 square miles of area dragged, 127 miles run while dragging, 849 positions determined (double angles), 72 retained soundings, 1 tide station established, scale of hydrographic sheets 1:20,000.

The party organized at Seattle, Wash., in April, 1917, for wire-drag work in Alaska, sailed for Alaska in the chartered steamer *L. Roscoe* on April 26 and arrived at Wrangell April 30 and at Juneau May 3.

The party proceeded to the working grounds May 7, and on the following day signal building and topographic work were begun. Dragging operations were begun May 16.

The hydrography completed by June 30 consists of a wire-drag examination of Favorite Channel and part of Stephens Passage on the west side of Douglas Island. The area covered extends from Sentinel Island to Point Young.

No important shoals dangerous to navigation were located. Several deep soundings not charted were obtained and three shoals with less than 50 feet of water were found. A number of uncharted rocks awash at low water were determined close inshore, and the depth on Spuhn Rock was reduced by 4 feet.

An automatic tide gauge was set up on the cannery dock at Auke Bay on May 15 and a continuous record obtained to the close of the fiscal year.

A topographic survey of the shore line adjacent to the waters dragged was carried on during the period covered by this report. The shore line completed extends from the mouth of Eagle River to Fritz Cove; on the northwest corner of Douglas Island from the edge of the flats to a point 2 miles below Outer Point; on the east side of Mansfield Peninsula, on Admiralty Island, a stretch of beach line about 7 miles long; on the south and east sides of Shelter Island; and including all the small off-lying islands in this section. Contours were determined back of these limits except on the mainland north of Point Lena where check measurements established the completeness and accuracy of the contours on the Geological Survey map of this region.

A short scheme of triangulation was laid out in Favorite Channel ahead of the work of the primary triangulation party under F. S. Borden, and horizontal angles had been observed at 5 stations on June 30.

Mr. Borden's work in recovering and locating certain controlling points in Stephens Passage was of assistance to this party, but as the primary work was not sufficiently advanced to give starting points for the surveys by the wire-drag party, it was necessary to recover additional stations on which to start the topography, and for this purpose three old stations in Fritz Cove were used. Additional signals were also built and located for use in the wire-drag work. Most of these signals were cut in by the triangulation party.

[A. JOACHIMS.]

**SUMMARY OF RESULTS.**—Triangulation: 85 square miles of area covered, 9 signal poles erected, 7 stations in main scheme occupied for horizontal measures, 4 stations in supplemental schemes occupied for horizontal measures, 15 geographic positions determined. Topography: 75 miles of general coast line surveyed, scale of topographic sheets 1:20,000. Hydrography (wire drag): 201.5 square miles of area dragged, 251.7 miles run while dragging, 9 soundings retained, 1 tide station established. Hydrography (sounding): 8.2 miles run while sounding, 132 positions determined (double angles), 708 soundings made.

In March preparations were made at Seattle for organizing wire-drag party No. 3 for work in southeastern Alaska. The steamer *Equator* and the launches *Roosevelt* and *Freya* were chartered for the use of the party. The *Equator* and *Roosevelt* reported at Ketchikan on April 16 and the *Freya* at Petersburg on May 1.

Headquarters were established at Petersburg where the launches were equipped for dragging, triangulation stations were recovered

and signals erected, and on April 27 drag work was begun in Frederick Sound.

During the period from April 27 to June 30 an area was dragged in Frederick Sound, starting on a line approximately east and west across the sound about 3 miles southeast of Frederick Point and ending at a line approximately north and south from Cape Fanshaw. The drag was set at an effective depth of 85 feet at mean lower low water, except over known shoal places near shore where this was not practicable. A small area in the vicinity and northwest of McDonald Island and also a little inshore work west of Farragut and Portage bays were not completed.

A great portion of the area was covered by a long drag using 300-foot to 400-foot sections. The drag was frequently tested and proved to be dragging the full depth set between buoys and with about 1-foot lift at the buoys.

The region dragged proved to be clear in most cases. A 60-foot shoal was located off Cape of the Straits and also a shoal with a least depth of 93 feet at mean lower low water south of the most westerly island of the Sukoi Group.

A determination was made by triangulation of the positions of Mount Elizabeth and Mount Cecil in the vicinity of Patterson Bay.

In the early part of the season it was necessary to run a tertiary scheme of triangulation in advance of the primary work to be done by E. W. Eickelberg. Three old stations Noon, Cape, and Bridge were recovered and used as a base. The work was extended westward from the old station Noon to Portage Island and Bay Point where it was tied onto the primary scheme. A few figures were also extended into Farragut Bay for planetable control.

Hydrography was done in vicinity of buoys 24 and 17 in Wrangell Strait and near the docks at Petersburg. Signals were erected over recovered triangulation stations and a few additional points located. The area was carefully developed by closely run lines and cross lines and soundings were made near the cannery and company docks.

A topographic party was kept steadily at work in the vicinity of drag operations. The shore line of three sheets was nearly completed. A number of mountain peaks were cut in by triangulation.

An automatic tide gauge was established at the old sawmill dock at Petersburg on April 22, and a continuous record of tides obtained from that date.

Tide staffs at stations Mitkof and Petersburg in Wrangell Strait were visited, lines of levels run to see that the zero marks of these staffs were properly set, and the staffs were repaired.

Notes were collected for use in the coast pilot volumes.

[C. G. QUILLIAN, Commanding Steamer *Patterson*.]

**SUMMARY OF RESULTS.**—Triangulation: 56 stations in main scheme occupied for horizontal measures, 63 geographic positions determined. Topography: 130 square miles of area surveyed, 248 miles of general coast line surveyed, 8 topographic sheets finished, scale 1:20,000. Hydrography: 90 square miles of area covered, 835 miles run while sounding, 5,779 positions determined (double angles), 30,726 soundings made, 2 tide stations established, 8 hydrographic sheets finished.

At the beginning of the fiscal year the steamer *Patterson* was engaged in triangulation, topography, and hydrography in the vicinity of the Kashevarof Islands, southeastern Alaska.

A planetable party and a sounding party were operated from the ship anchored in Lake Bay, while two planetable parties and a hydrographic party were camped at Exchange Cove.

Afterwards the topographic and hydrographic parties working from Lake Bay were placed in camp there, while the personal supervision of the chief of party was given to the parties in Exchange Cove, and the secondary triangulation through Snow Passage was taken up.

After the completion of the secondary triangulation in Snow Passage and most of the topography and hydrography in Kashevarof Passage, work was begun on the west side of Etolin Island.

A house-scow was chartered and fitted up to accommodate 3 officers and 10 men. This scow was tended by the launch *Delta* and various small power boats, and from it were operated one sounding party and one to two topographic parties. The work along the west side of Etolin Island and Dewey Anchorage was undertaken by this party.

The general survey was continued along the coast of Etolin Island southward from Point Harrington to McHenry Anchorage, excepting Mosman Inlet and the sounding in Burnett Inlet. McHenry Inlet and Dewey Anchorage and the passages through Onslow and Stone Islands were surveyed.

The triangulation control was extended through Zimovia Strait and a reconnoissance survey made of the narrows in Zimovia Strait.

An automatic tide gauge was maintained at Lake Bay during the entire season.

Staff gauges were established at Exchange Cove, Bushy Island, McHenry Inlet, and Zimovia Strait.

During the latter part of the season two tide staffs were established in Wrangell Strait for the use of passing vessels. These staffs were marked in the following manner so that their purpose was obvious to the mariner: "Tide Staffs, U. S. Coast and Geodetic Survey. Add staff readings to charted soundings."

Work was completed in October. The *Delta* and other boats were stored at Metlakatla and the *Patterson* returned to Seattle October 31.

[C. G. QUILLIAN, Commanding Steamer *Patterson*.]

**SUMMARY OF RESULTS.**—Reconnoissance: Length of scheme 38 miles, 30 square miles of area covered, 57 points selected for scheme. Triangulation: 11 square miles of area covered, 56 signal poles erected, 38 stations in main scheme occupied for horizontal measures, 8 stations occupied for vertical measures, 34 geographic positions determined. Magnetic work: 2 land stations occupied for magnetic declination, 7 sea stations occupied for magnetic declination, dip, and intensity, ship completely swung at 7 sea stations. Topography: 40 square miles of area surveyed, 39.8 miles of general coast line surveyed, scale of topographic sheets 1:20,000. Hydrographic: 5.9 square miles of area covered, 52.5 miles run while sounding, 456 positions determined (double angles), 867 soundings made, 1 tide station established, scale of hydrographic sheet 1:20,000.

On April 25, 1917, the *Patterson* sailed from Seattle to resume work in Alaska, stopping at Port Townsend to swing ship for compass deviation.

On arrival at Metlakatla, Alaska, the launch *Delta* was put in commission and the other boats taken from storage.



The *Delta* was towed from Metlakatla to Juneau where the bunkers were filled and the vessel proceeded to the working ground on May 12. Stag Bay was made the headquarters.

After making a reconnoissance the work was started by building triangulation stations and preparing to extend the triangulation from Cross Sound through Lisianski Inlet and Strait.

A camp party was landed on Miners Island at the junction of Lisianski Inlet and Lisianski Strait. The *Delta* and launch 38, a motor boat, and several skiffs were moored for their use.

On May 24 the *Patterson* struck an uncharted rock in Lisianski Strait and injured the rudder. The vessel made Inian Cove, Cross Sound, under her own power without assistance. Here the rudder was unshipped and brought on deck for temporary repairs. May 27 the wire-drag tug *L. Roscoe* towed the *Patterson* into Juneau and moored her at the Ready Bullion dock of the Alaska Treadwell Gold Mining Co., at Treadwell. The rudder was sent to the machine shop of the Alaska Treadwell Gold Mining Co. and the split stock reinforced with a metal jacket, and a new pintle and a new gudgeon cast.

A diver was obtained and a survey made of the bottom. The diver reported the blows as all keel blows and that excepting the rudder the damage was to the shoe and the false keel. He further reported that, so far as a diver's examination could determine, the hull and keel were uninjured and sound and the vessel seaworthy.

The splintered wood of the false keel was faired off, torn sheathing replaced, missing sheathing renewed with sheathing or lead to protect the keel from toredoes, and a shoe nailed in place. The new gudgeon was shipped and the rudder shipped in place.

From the return of the vessel to the working ground on June 18 until the end of the fiscal year on June 30 the weather was unfavorable for work, there being almost continual rainy spells, and no off-shore work was done.

During the time the vessel was being repaired in Juneau, the camp party made good progress and carried the triangulation down Lisianski Inlet and Strait to Stag Bay and extended the topography almost as far. The hydrography of the narrow portions of Lisianski Strait was completed first for use of the ship and in expectation of vessels being sent into the cannery in construction in Stag Bay.

At the end of the fiscal year the progress of the work was as follows: Triangulation completed from Cross Sound to below Stag Bay and signals built to Point Urey; reconnoissance and some of signals built for several figures into Lisianski Inlet below Junction Island; topography completed to Stag Bay. No offshore soundings had been made.

En route to Alaska the ship was completely swung for magnetic observations for declination with standard compass and for dip and total intensity with the Lloyd-Creak Dip Circle at the following seven places: Port Townsend, Wash., and Gulf of Georgia, Queen Charlotte Sound, Lama Passage, Fraser Reach, Milbank Sound, and Chatham Sound, British Columbia.

Valuable assistance was rendered by the Alaska Treadwell Gold Mining Co. of Treadwell, Alaska, in reinforcing rudder; the Chichagof Mining Co. of Chichagof, Alaska, in carrying mail and sup-

plies to the camp party and in bringing mail to the ship on the working ground; the Icy Straits Packing Co. of Juneau, Alaska, in carrying supplies to the camp party from Inian Cove shortly after the injury to the rudder; the Lisianski Packing Co. by bringing supplies to the camp and to the ship, and by Joseph T. Bauer, M. S. E., retired, the owner and manager of the Chichagof radio station, in keeping the *Patterson* in radio communication with Seattle and Washington.

[F. H. HARDY, Commanding Steamer *Explorer*.]

**SUMMARY OF RESULTS.**—Triangulation: 455 square miles of area covered, 19 stations in main scheme occupied for horizontal measures, 3 stations occupied for vertical measures, 38 geographic positions determined. Leveling: 7 permanent bench marks determined, 2 miles of levels run. Topography: 45 square miles of area surveyed, 109.9 miles of general coast line surveyed, 4 topographic sheets finished, scales 1:10,000, 1:20,000, and 1:40,000. Hydrography: 209 square miles of area covered, 745.1 miles run while sounding, 7,332 positions determined (double angles), 6,803 soundings made, 3 tide stations established, 5 hydrographic sheets finished, scales 1:10,000, 1:20,000, and 1:40,000.

At the beginning of the fiscal year the party on the steamer *Explorer* was engaged in general surveys on the outside coast of Dall Island, southeastern Alaska. Progress to June 30 is stated in the last annual report.

The area of hydrography was divided into three parts, the first extending from the longitude of Forrester Island west to the 1,000-fathom curve, the second from the inshore hydrography to the longitude of Forrester Island, and the third to include all the inshore hydrography as well as that of the bays and harbors of the outside coast of Dall Island.

It was found impracticable in the season available to accomplish any of the work in the section first mentioned.

The second division of the work of the hydrography was accomplished by the party on the *Explorer*.

The third division of the hydrography was accomplished by parties working from bases in Security Cove, Port Bazan, and Waterfall Bay.

The extension of the triangulation from the work of 1915 south from triangulation station Luzon was done by subparties on the *Cosmos* and launch No. 117.

The topography of Forrester Island and the shore line of Dall Island from Cape Augustine to join the work of R. B. Derickson, was executed by detached parties on the *Cosmos* and working from camps with launches No. 117 and No. 46.

Lines of soundings were run east and west between latitude  $54^{\circ} 36'$  and  $55^{\circ} 05'$ , spaced according to the prevailing depths from 1 to 4 miles apart. The bottom is extremely irregular especially north of the line between Forrester Island and Point Augustine.

This area being exposed to the full sweep of the sea, kelp could not be relied upon as an indication of danger. The best indication of such dangers was a break after a strong westerly blow. The inshore hydrography around Forrester Island and most of that on the outer coast of Dall Island was done by a party on the launch *Cosmos*. Some inshore work north of Port Bazan was done by a party on launch No. 117. The hydrography of Port Bazan was done with

launches *No. 117* and *No. 42*; the hydrography of Waterfall Bay by a party on launch *No. 117*.

The reconnaissance for triangulation was done by parties working with launch *No. 117* from the ship.

Triangulation stations Augustine, Bazan, and Cornwallis were so chosen that intermediate points along the Dall Island coast could be located from them without observations from station Forrester.

The topography of Forrester Island and the outside coast of Dall Island from Cape Augustine to Port Bazan was done by a party on the *Cosmos*.

The topographic work from the previous topography in the vicinity of Cape Muzon was done from a camp in Security Cove. This party took advantage of clear days to do triangulation, and during weather when it was impossible to land on the outside coast, engaged in inshore hydrography.

The topography of Port Bazan was done on a scale of 1:10,000. The topography of Gooseneck Bay, Gold Harbor, and Waterfall Bay was done by a party in camp working with launch *No. 42*.

[T. J. MAHER, Commanding Steamer *Explorer*.]

**SUMMARY OF RESULTS.**—Triangulation: 30 square miles of area covered, 5 observing scaffolds and tripods built. Leveling: 3 miles of levels run, 3 permanent bench marks established. Topography: 2 miles of general coast line run (locating signals). Hydrography: 574 square miles of area covered, 931.6 miles run while sounding, 3,716 positions determined (double angles), 3,885 soundings made, 1 hydrographic sheet finished, 1 partly finished, scales 1:20,000 and 1:120,000. Physical hydrography: 3 deep-sea current stations occupied, 26 deep-sea surface current observations made.

The steamer *Explorer* left Seattle for Alaska on May 1, arriving in Port Chester May 7. After starting repairs to launch *No. 117* the steamer proceeded to Ketchikan for coal.

On May 14 ship hydrography was begun off Cape Muzon. Signals in the vicinity of the cape were located for the use of the steamer *Cosmos*. In the offshore hydrography, lines were run by the ship out to the 1,000-fathom curve, while the party on the *Cosmos* ran lines of soundings from Cape Muzon to Port Bazan, confining its work to an area extending 2 miles offshore. Various gaps existing in previous work were filled in, and work in that section is now complete.

The ship work extends north from parallel  $54^{\circ} 38'$  and west from the shore of Dall Island for 55 nautical miles, and covers a lane of about 6 nautical miles, widening somewhat at the offshore end. From Cape Muzon to a distance of about 6 miles the soundings were less than 100 fathoms. For about 55 miles beyond that, depths ranged between 100 and 200 fathoms, shoaling somewhat near the outer edge. The bottom slope then became steep, dropping off rapidly to 1,000 fathoms.

Soundings in depths between 100 and 200 fathoms were made one-half mile to 1 mile apart, the greater number being spaced the shorter distance. The lines are approximately 1 mile apart. A line of soundings was run north  $40^{\circ}$  east from the 1,000-fathom curve to the entrance of Meares Passage. This crosses an area west of Forrester Island concerning the depths in which there was no previous information.

During former seasons widely spaced lines were run in the area east of Forrester Island and Lowrie Rock. Of this area a rectangular section extending 6 nautical miles due east of Forrester Island and  $9\frac{1}{2}$  nautical miles north was developed. The ship anchored at night in from 50 to 60 fathoms of water about 5 miles east of Forrester Island. Currents were observed at such times.

Tide staffs were erected at Cape Muzon and at Gooseneck Bay. The automatic gauge at Craig was in operation during the season.

On June 18 the ship was at Klawak coaling. On June 20 she left for the working grounds. Weather conditions were unfavorable and only three days' hydrography could be done by the ship. The *Cosmos* was able to get in only two days' work before the end of June. Some triangulation was done to locate signals for the control of the hydrography at the entrance to Meares Passage.

[E. E. SMITH, Commanding Steamer *Taku*.]

**SUMMARY OF RESULTS.**—Reconnaissance: Length of scheme 21 miles. Triangulation: 157 square miles of area covered, 12 signal poles erected. Topography: 55 square miles of area surveyed, 103 miles of general coast line surveyed, 5 topographic sheets finished, scale 1:20,000. Hydrography: 111.5 square miles of area covered, 1,264.2 miles run while sounding, 6,120 positions determined (double angles), 40,743 soundings made, 2 tide stations established, 35 current stations established, 6 hydrographic sheets finished, scales 1:10,000, 1:20,000, and 1:80,000.

The survey of Orca Inlet and the Copper River delta begun in April, 1916, was in progress at the beginning of the fiscal year.

The topography of Orca Inlet on a scale of 1:20,000 was done when the weather was unfavorable for work elsewhere. On the east side the short line was run from Point Whitshed to Cordova, on the other side from abreast of Cordova nearly to Canoe Pass. Contouring was done chiefly from photographs made with the photo-topographic camera.

The hydrography of Orca Inlet was closely sounded out with the hand lead by the *Taku* and small boats. In the endeavor to find a channel through from Cordova to the sea all sloughs were developed throughout.

A planetable survey was made of Boswell Bay on a scale of 1:20,000. The outer sandy shore shows some changes.

The hydrography of Boswell Bay was done on a scale of 1:10,000. This bay is small and offers swinging room for about three small vessels. The large rocks at the entrance to the bay make excellent landmarks.

In the region between Point Bentinck and Egg Islands, the islands which show above high water were located by sextant positions, the topographer noting his angles at turns in the shore line or other suitable places, making sketches and plotting on the smooth sheet.

In this vicinity the deeper sloughs were sounded from the *Taku*. Over the flats and smaller sloughs the whaleboat party worked. Outside the bars the soundings were made by the *Taku* running as close in to the breakers as practicable. Work outside was carried to about 15 miles east of Point Bentinck with a gap between but was not completed to the 10-fathom curve when the season closed as the sea would seldom permit the *Taku* to work here. The inner part was sounded on a scale of 1:20,000, but the outer part required the use of distant peaks for signals and was done on 1:80,000 scale.

The topography between Egg Islands and Pete Dahl Slough was located by sextant in the same manner as that of Egg Islands.

The hydrography of Alaganik Channel was done by the *Taku* and the whaleboat. The flats and small sloughs in the vicinity were covered by the whaleboat. A line of sounding was carried through Steamboat Slough and the Race Track by the *Taku*, and further development was made by the small-boat party.

In Kokinhenik Slough a reconnoissance line plotted on the 1:80,000 smooth sheet was sounded to Kokinhenik following the reported lowest part of the flats. In the vicinity of Kokinhenik Island enough work was done with the planetable to locate hydrographic signals. Considerable changes were noticed in the shore line, more than half of Kokinhenik Island having washed away since 1898. The deeper water in the vicinity was located and followed up until it vanished among the sand flats from which it originated.

Triangulation stations Camp, Girl, and Beach were recovered, and stations Mock and Egg were established on the sand bars and station Whitshed 1916 on the rock that sustained a former station of the same name, making a five-pointed figure for which observations were made. It was intended to continue the scheme with quadrilateral Mock-Whitshed-Mike-Egg, but station Mock was washed away before Mike was occupied, and station Coin was established near station Mock and the scheme carried through.

Radio towers in the vicinity of Point Whitshed were located from stations previously established on Orca Inlet. The new naval radio towers 13 miles from Cordova were also located by triangulation.

Observations with compass declinometer were made at triangulation stations Beach, Trade, and Egg.

An automatic tide gauge was established at the edge of the channel near the Point Whitshed wireless station and connected with bench marks previously established.

Comparative readings were made at Alaganik Slough entrance, Kokinhenik Island, and Boswell Bay.

Current observations were made whenever the vessel anchored.

On October 5 the *Taku* was beached in the slough at Cordova, hauled into her winter berth and laid up for the season.

Work was closed October 17 and on the 19th the party sailed for Seattle.

The Coast and Geodetic Survey chart agency at Cordova was inspected in the spring and just before leaving in the fall. The agency at Juneau was inspected as the party returned to Seattle.

[A. J. ELLA.]

The field revision of the Alaska Coast Pilot, Part I, begun in May, 1916, was continued in July, August, and September.

The officer engaged in this work traversed the various channels of southeastern Alaska, traveling on chartered launches, regular mail launches, and steamers. He took advantage of opportunities to locate several uncharted rocks and examine reported doubtful areas, in addition to obtaining the usual coast pilot information supplemental to that in the last published volume.

Field work was closed September 22.

[FRANK S. BORDEN.]

**SUMMARY OF RESULTS.**—Triangulation: 130 square miles of area covered, 27 signal poles erected, length of scheme 28 statute miles, 25 stations in main scheme occupied for horizontal measures, 1 station in supplemental scheme occupied for horizontal measures, 25 geographic positions determined.

In accordance with instructions issued March 9, 1917, a party was organized at Seattle and left for Juneau, Alaska, on April 13, to carry on the work of primary triangulation in Stephens Passage, southeastern Alaska. Field work was begun on April 25.

The object of this triangulation is to furnish control for the work of the wire-drag party under L. O. Colbert operating in this locality and also to furnish a strong scheme of triangulation through southeastern Alaska on which all triangulation of a lower grade may be based.

The triangulation was carried northwestward up Stephens Passage, through Favorite Channel to the line Little-Sentinel on Little and Sentinel Islands at the entrance to Lynn Canal. From the main scheme stations of the triangulation all hydrographic signals, prominent objects, and peaks were located. From the line Little-Sentinel, which is as far north as the scheme was carried in the season, hydrographic signals were located as far north as Cape Bridget.

The triangulation was connected with the line joining stations Cow-Bib of the old triangulation, and the field computations are based on the old positions of those two stations.

The main scheme of triangulation executed up to the end of the fiscal year is 28 statute miles in length and includes 25 main scheme stations. The average closure of 47 triangles in the scheme is 0.77 second. The longest line is slightly over 7 miles in length and the shortest line is slightly less than 1 mile in length.

[E. W. EICKELBERG.]

**SUMMARY OF RESULTS.**—Reconnaissance for primary triangulation: Length of scheme 52 miles, 425 square miles of area covered, 35 lines of intervisibility determined, 16 points selected for scheme. Primary triangulation: 425 square miles of area covered, 15 signal poles erected, 1 observing tripod and scaffold built (height 52 feet), 14 stations in main scheme occupied for horizontal measures, 9 stations occupied for vertical measures, 30 geographic positions determined, 10 elevations determined trigonometrically.

The work of primary triangulation of Frederick Sound, southeastern Alaska, was begun April 23, 1917. This work was carried on in the most advantageous location for furnishing geographic positions for the wire-drag party.

On account of the numerous icebergs in the lower end of Frederick Sound the drag operations could not be carried on there, and the triangulation was begun in the vicinity of Cape Fanshaw, instead of in Dry Strait where triangulation work had been done during the previous season. The area available for wire-drag work and controlled by geographic positions at the close of the fiscal year was 425 square miles. This comprises 16 primary stations and furnishes 30 geographic positions.

This triangulation supplements that done by the party under F. S. Borden and forms part of an arc of primary triangulation that will extend from Dixon Entrance northward to White Pass at the

head of Lynn Canal. The arc will eventually extend from Puget Sound in Washington to the intersection of the Yukon River and the one hundred and forty-first meridian boundary between Canada and Alaska. The Geodetic Survey of Canada plans to do the triangulation along those portions of the arc which fall within its territory. When this arc is completed all of the triangulation of Alaska can be placed on the North American datum, which will make it possible to compute permanent latitudes and longitudes for the triangulation stations.

#### SITKA MAGNETIC OBSERVATORY.

[J. W. GREEN.]

The regular work of the magnetic observatory at Sitka has been continued without material interruption, and practically continuous records have been obtained.

Absolute observations, consisting of three sets of declination, two sets of dip, and the regular double set of horizontal intensity, were obtained on one day of each week.

Time observations from noon transits of the sun were obtained when practicable.

Thirteen magnetic storms were recorded during the fiscal year and in addition 10 disturbances of less intensity.

The seismograph was kept in constant operation. The seismic activity was very slight, only 18 earthquakes of slight intensity having been recorded during the year.

New office quarters for the observatory were erected during the first half of the year.

A set of magnetic instruments from the steamer *Patterson* was standardized at the observatory.

#### PORTO RICO.

[HAROLD W. PEASE.]

In September field magnetic observations were made at three stations, Mayaguez, Ponce, and San Juan South Base.

The old stations could not be found or were no longer suitably located, so new stations were established near by.

#### PORTO RICO MAGNETIC OBSERVATORY.

[HAROLD W. PEASE, July 1 to Sept. 13, 1916; F. L. ADAMS, Sept. 14, 1916, to June 30, 1917.]

At the magnetic observatory at Vieques, P. R., a practically continuous record was obtained from the magnetograph and seismograph, and 24 earthquakes were recorded during the year.

Absolute observations were made twice each week. Time observations were made as often as necessary, and scale-value observations were made at least once each month.

On August 22 part of the roof of the observatory was blown off by a hurricane. The necessary repairs were made as soon thereafter as

possible. Another hurricane on October 9 did further damage to the buildings, which was also repaired. Further necessary repairs were afterward made to the buildings.

At the time of the hurricane of August 22, the absolute instruments were moved to the seismograph house for safety. When re-mounted on its pier, the earth inductor was found to be out of order and had to be sent to the office for repairs; it was out of use until the following April. Dip observations were made with a dip circle in the interval, and the two instruments were compared in April and May.

## HAWAII.

### HONOLULU MAGNETIC OBSERVATORY.

[WILLIAM WALTER MERRYMON, July 1 to July 23, 1916; FRANK NEUMANN, July 24, 1916, to June 30, 1917.]

The usual variation observations were recorded continuously during the year near Honolulu.

Absolute observations were made once each week, and scale value determined once a month.

The Milne seismograph was kept in continuous operation, and 149 earthquakes were recorded, most of them, however, being of very small amplitude.

Meteorological observations were continued and the results reported to the United States Weather Bureau office at Honolulu.

## PHILIPPINE ISLANDS.

[FREMONT MORSE, Director of Coast Surveys.]

The one fact standing out above all others during the period covered by this report is the great increase in cost of all articles of supply. Coal in particular has been increased more than 100 per cent in price at most of the insular coaling stations.

In the face of this increase and with a fixed allotment, it is obvious that only by rigid economy and careful planning of operations could the various ships be kept in the field. In hydrographic work the great expenditure of coal is made in connection with ship soundings. Hence the endeavor was to keep the vessels at such work as would involve the least amount of this class of work. Thus, on the Palawan coast the main endeavor was to keep the *Marinduque* and *Romblon* as much as possible on inshore hydrography, topography, and the main triangulation of the island.

Had the Survey been obliged to obtain all its coal from the bureau of supplies at the rates quoted there would have been no alternative but to lay up some of the ships before the end of the year. Fortunately, it was possible to obtain coal for the *Pathfinder* and *Marinduque* from the Navy at greatly reduced prices, and the *Romblon* was supplied at Sandakan, Borneo.

The coal account was also reduced during the last six months of the year by the execution of the repairs to the *Pathfinder* by the Navy at the Olongapo station. Owing first to lack of material and later to the rush of naval work incident to the severance of diplomatic relations with Germany and subsequent declaration of war,



the *Pathfinder* was detained at Olongapo from January 17 to June 4. During that time she was not burning coal, and the saving on her fuel bills was all that prevented, even with the help of the Navy and the Sandakan coal supply, the laying up of one or more of the ships for a certain period toward the end of the year.

Other supplies have in like manner become more expensive. Prices have increased from 50 per cent to 75 per cent on practically all the articles needed to run the ships.

An unusual amount of repair work on the steamers *Romblon* and *Research*, funds for which purpose were provided by the Philippine Emergency Board, was made necessary by the rapid deterioration caused by the age of the ships and the tropical climatic conditions.

#### FIELD WORK.

At the beginning of the fiscal year the steamer *Pathfinder* was engaged in combined operations in the vicinity of Balabac Island. Weather conditions early in July rendered it advisable to suspend work in that locality and the ship returned to Manila where certain necessary minor repairs were made. After August 1 the *Pathfinder* was engaged in general surveys about Burdeus Bay and the islands to the eastward of Polillo until October when extensive repairs to the vessel were begun at Olongapo.

As it was not possible to finish all needed repairs at once, the vessel returned to the working ground at Balabac and was actively engaged in surveying work at the end of December.

Shortly after the beginning of the calendar year the vessel returned to Manila for transfer of officers and resumption of repairs at the Olongapo Naval Station. She reached Olongapo on January 17, and remained there until June 4. This long delay was occasioned by the necessity for repairs to the ships of the Navy rendered imperative by the severance of diplomatic relations with Germany and the final declaration of war.

On the completion of the repairs it had been the intention to have the *Pathfinder* resume work about Balabac Strait, in order that she might be handy to the cheapest source of coal supply, Sandakan, Borneo. The plan was changed when the naval authorities, instead of merely letting the vessel have a few tons of coal to take the ship to Sandakan, kindly filled her bunkers, and thus enabled the work to be taken up in the vicinity of Polillo Island, where on account of the interest in that locality caused by the formation of a national coal company by the Philippine Government, it has become necessary to have better charts.

The coal deposits on Polillo are said to be among the most promising prospects in the islands.

The Navy Department also desired more detailed surveys in that vicinity, and the *Pathfinder* will complete these with the help of the *Fathomer* during the prevalence of the southwest monsoon. To this end it has been arranged that the Navy will furnish coal for both ships, thus very materially aiding the work.

At the close of the year the *Pathfinder* was on the working ground.

The steamer *Fathomer* was at Manila undergoing repairs until September 11 when she sailed for Busuanga Island where surveys

were in progress at the end of December. By that date the survey of the north coast of the island was approaching completion.

The *Fathomer* continued her regular work in the vicinity of Busuanga Island during the entire period from January 1 to June 30. Among the important results of her surveys was the discovery of a small but well-protected harbor not previously shown on any chart on the northwest coast of Busuanga, suitable for a typhoon refuge.

The topography of Busuanga and outlying islands was completed, and a short field season will finish the hydrography in this region.

Many hitherto uncharted shoals were located and sounded out. The commanding officer mentions about 30, of which 3 are of large extent.

Owing to an urgent request from the Navy for a speedy completion of the surveys in the vicinity of Polillo Island, the *Fathomer* will assist the *Pathfinder* after July 1, and the Busuanga work will be postponed for a time.

The most important work accomplished by the steamer *Marinduque* was the reconnoissance, signal building, and observing for the main scheme of triangulation of Palawan Island, which was carried to the vicinity of Puerto Princesa, completing in connection with work previously executed, a strong scheme available for both coasts for more than half of the entire length of the island. After the determination of the triangulation points, the ship was chiefly engaged in triangulation. Enough topography was executed to keep ahead of the other work.

The *Marinduque* continued her work on the east coast of Palawan after a period of repairing and outfitting in Manila. She sailed for her working grounds on February 10, and has been engaged in topography and hydrography in Green Island and Honda Bays and on the reconnoissance and observing for the main scheme of triangulation of the island of Palawan. This work is extremely arduous, as the scheme involves the occupation of the high mountain peaks far back from the coast. In fact, so far as carried down the island by the party of the *Marinduque*, the triangulation is so planned and executed as to be available for the survey of both the east and west coasts. By the end of the year the scheme had been laid out down as far as a nearly straight line across the island from Albion Head on the west coast to Aloaba, a peak in the interior of the island, and thence to Tagalipog Island, off the east coast, below Separation Point; and the observations were well under way. It required eight days to reach the most difficult station on Victoria Peak, 5,680 feet high.

At the beginning of the fiscal year the steamer *Romblon* was at work in the Cuyo group engaged in filling in gaps in previous work. A small amount of hydrography was done at San Jose, Panay.

Between August 1 and September 19 the vessel was undergoing repairs at Manila, after the completion of which field work was resumed in the same locality as before. On December 19 the work in the Cuyo Islands was finished and the vessel returned to Manila.

The *Romblon* resumed field work, general surveys, at the south end of Palawan Island on February 16. She returned to Manila for repairs and supplies March 19 and resumed her work in the field in the same locality on April 15 and was still there at the end of the year.

During the first part of this period, the prevalence of the northeast monsoon rendered work impracticable except in sheltered localities. Hence the topography and hydrography around the southern part of Palawan and up the west coast were first taken up. The former was completed up to Reposo Point and the latter nearly to Capiyas Island.

The reconnoissance for the main scheme of triangulation up the island was later taken up and by the end of June had been extended to Brooks Point, ending on the line from this point to Mount Mantalingajan.

The topography was also completed on the east coast of Bugsuk Island and extended up the east coast of Palawan as far as Iglesia Point. The inshore hydrography was also completed to the same point, and considerable offshore work was done extending still farther north.

The extension of the triangulation scheme to Brooks Point leaves a gap of only about 30 miles between the work of the *Romblon* and that of the *Marinduque*.

At the beginning of the fiscal year the steamer *Research* was undergoing extensive repairs at Engineer Island which were not completed until August 9. On the 15th the vessel proceeded to Iloilo to take up the survey of Oton Bank and vicinity on which work she was engaged until October 12. The *Research* then returned to Manila for transfer of the command, which was effected October 18, and afterwards a general survey was begun of that portion of Manila Bay which had not been surveyed by the Coast and Geodetic Survey. Work was begun at the entrance and continued along the west shore toward the head of the bay. This survey was still in progress at the end of the fiscal year.

A new scheme of triangulation was executed for the control of the work in the northern end of the bay, extending up the two navigable streams that empty into it, the Pasag and Orani.

In the course of this triangulation the positions of the new radio towers on Sangley Point, the Masonic Temple in the city of Manila, and other prominent objects useful for navigation as well as for surveying purposes were determined. Owing to the low and swampy nature of the country about the bay, some scaffold signals from 40 to 50 feet in height were necessary, and water signals constructed of bamboo were used in some instances out in the bay for hydrography. The land stations were permanently marked with concrete posts, set deep in the ground and with their tops projecting about 6 inches above the surface.

The topography was run in about the bay except where previous surveys covered the ground. For use in the hydrography a plane-table survey of the shore line for the location of signals was made along the previously surveyed portion.

#### OFFICE WORK.

The routine of the Philippine suboffice was continued with only a few important changes. A nautical expert was assigned to take charge of the chart division, and a topographic draftsman sent from the United States was placed on duty in the drafting division.

On the resignation of the former chief of the geographic division, the duties of that division were turned over to the drafting division, which now conducts all the drafting work of the office.

The computing division, besides checking all field computations and making final least square adjustments of the different triangulation schemes, has charge of the records pertaining to triangulation, hydrography, and tides.

The main endeavor has been to complete the adjustment of minor schemes and points in regions where the main scheme had been previously adjusted and to extend the computation of geodetic positions on the Luzon datum.

In the drafting division tracings for two new charts, and one correction piece for a new edition were forwarded to Washington during the first half of the fiscal year. Eight chart drawings in various stages were on hand on December 31.

In the geographic division good progress was made on map No. 100 covering the entire Philippine group on a scale of 1:1,000,000. The completion of this map was delayed by the receipt of new and important data making necessary the reconstruction of part of the map, which will be prepared for publication in four sheets.

Three other maps were in course of construction on December 31, covering Mindanao, Samar, and northern Luzon.

One new map, No. 8, of southern Luzon, central sheet, on a scale of 1:200,000, was received from Washington and placed on sale.

Hand corrections were made to published maps to keep them as nearly as possible up to date.

A large number of miscellaneous maps are kept on hand for reference, which together with the list of municipalities and townships, constitute a very useful collection of geographic data.

The chart division receives and registers all documents that contain information affecting the charts and coast pilots, and publishes local notices to mariners in regard to dangers discovered by the surveying vessels.

It also attends to the correction, sale, and distribution of the published charts.

[H. C. DENSON, Commanding Steamer *Pathfinder*.]

**SUMMARY OF RESULTS.**—Triangulation: 227 square miles of area covered, 33 signals erected, 4 observing tripods and scaffolds built, heights 81, 91, and 110 feet, 33 stations in supplemental schemes occupied for horizontal measures, 40 geographic positions determined, 2 elevations determined trigonometrically. Topography: 33 square miles of area surveyed, 116 miles of general coast line surveyed, 5 miles of rivers surveyed, 4 miles of creeks and sloughs surveyed, 2 topographic sheets finished, scale 1:20,000. Hydrography: 1,034.4 square miles of area covered, 3,443 miles run while sounding, 10,137 positions determined (double angles), 37,561 soundings made, 3 tide stations established, 7 hydrographic sheets finished, scales, one 1:60,000, six 1:20,000.

From July 1 to July 10 the party on the steamer *Pathfinder* was occupied in combined operations in the vicinity of Balabac Island. On account of weather conditions the work was suspended on July 11 and the ship proceeded to Manila arriving on July 14. The remainder of the month was occupied in making minor repairs and outfitting. This work being completed the vessel sailed from Manila for the working ground in vicinity of Polillo Island on August 1.

Field operations were begun at the north end of Burdeus Bay on August 4, and the survey of the Uala Group and other islands to the eastward of Polillo was engaged in until October 17 when the northeast monsoon had become well established and made it impracticable to continue field operations in this vicinity. The *Pathfinder* then returned to Manila to undergo extensive repairs to her hull, but on account of lack of material, the work on the hull was deferred until the arrival of the necessary material from the United States. The vessel was docked, however, at the Olongapo Naval Station, and such repairs as could be done at the time were completed. The *Pathfinder* then returned to Manila, outfitted, and proceeded to Balabac Island to continue the operations suspended in July. On December 31 this work was in progress.

During the season in vicinity of Polillo Island eight typhoon warnings were received, but the center of only one of these storms passed near. The heavy swell from distant storms made it impracticable, however, to land parties for topographic work or to engage in inshore hydrographic work on the north coast of Polillo Island.

From December 11 to 31, while operating in the vicinity of Balabac Island, on seven days only were the conditions favorable for topographic work, and on three of these the work had to be done between rain squalls.

The purpose of the triangulation in the vicinity of Polillo Island was merely to secure control for the topography and hydrography in the Uala Islands and on the northeast coasts of Polillo and Patnanogan Islands. To accomplish this it was necessary to extend the old scheme through a number of figures in order to establish new triangulation stations with the necessary lines of visibility for locating the topographic signals.

From old stations on the reefs south of Palasan Island a line was determined on the high ridge of Polillo Island, and from this new line the scheme was expanded to the northward and eastward, thus determining a station on an island off the north coast of Polillo and carrying the control through Uala Islands and to the east end of Patnanogan Island.

At Malolo and Hill on the highest point and northeast point, respectively, of Polillo Island, high instrument stands and scaffolds were necessary.

At Malolo an instrument stand 72 feet in height and scaffold (height of signal 91 feet) were built as separate structures and completed in two days.

At Hill a platform and stand combined were built in the upper branches of a single tree, giving an instrument elevation of 90 feet and a signal 110 feet above ground. This tree was cross braced to two other trees, the work requiring a day and a half in all.

The topography of Polillo Island was done from a camp on Anibawan Bay, the only safe anchorage for small boats. As the work progressed it was necessary to transport the parties a considerable distance to and from work. Along the north shore of Patnanogan Island where it is heavily fringed with mangroves, work could be done only at low tide.

The work in this vicinity was done on two sheets, including 51 and 20 miles of shore line, respectively.

The topographic work done in the vicinity of Balabac Island includes the shore line of Canabungan, Secam, the north side of Bancalan Islands, and a part of the west side of Balabac Island. This was done on three days between December 12 and 19.

During the entire time the ship was in this vicinity, December 11 to January 5, a heavy swell from the China Sea prevailed and landings were difficult.

The shore of the islands exposed to the China or Sulu Sea consists of sand beaches. The west coast of Balabac Island is a sand beach. The reefs, which extend far offshore, break up the swell so that at all times, even at high tide, the planetable may be set up at the most advantageous points. Along this coast traverse lines must be run in advancing the work of surveying the shore line.

Thirteen miles of shore line were completed. No contouring was done.

The hydrography in the vicinity of Polillo Island developed two deep-water entrances into Burdeus Bay from the eastward, also a harbor (Anibawan Bay) to the northeastward of Burdeus Bay on Polillo Island, which is well protected and affords good shelter from winds in any direction. The depths range from 5 to 20 fathoms, mud bottom.

In the survey of the area around Uala Islands, many anchorages were developed that are safe during the ordinary monsoons but not during typhoon weather.

The area between Polillo, Jomalig, and Balesin Islands was surveyed with the result that the depths were found uniform, ranging from 30 to 60 fathoms. The inshore work on the west coast of Baleskin Island indicated a very irregular bottom, but the survey had to be closed on account of weather conditions before a thorough development had been made.

The work during December around Balabac Island was confined to North Balabac Strait, which was completed.

An automatic tide gauge was installed at Burdeus Bay and three months' continuous observations were obtained.

During the survey of North Balabac Strait, staff readings were made at Calandorang Bay.

The *Pathfinder* continued work in Balabac Strait until the middle of January when she returned to Manila for transfer of officers and the resumption of repairs at the Olongapo Naval Station. She reached Olongapo on January 17 and remained there until June 4, when work was taken up in the vicinity of Polillo Island. This work was in progress on June 30.

The results of the field operations consist of the completion of the charting of North Balabac Strait, the Uala Islands off the east coast of Polillo, and the development of a safe typhoon anchorage (Anibawan Bay) and its approaches, on the northeast coast of Polillo. The work accomplished is principally hydrographic and covers a comparatively small area on account of close development being necessary.

The triangulation executed was only of a supplemental nature to determine sufficient geographic positions for topographic and hydrographic control.

The topography consists of the survey of the shore line bordering North Balabac Strait, the Uala Islands to the eastward of Polillo, also the northeast coast of Polillo, including Anibawan Bay.

In order to locate signals to control the hydrographic work between Polillo and Patnanongan Islands, a planetable traverse was run on the shores of these islands that had been previously surveyed in 1907 and 1908.

The hydrographic work accomplished during the year completes an area of 1,036 square miles and is plotted on seven sheets, one 1:60,000 and six 1:20,000.

The ship's work consisted of the survey of North Balabac Strait, the area to the southward of Polillo and Patnanongan Islands, also the approaches from the eastward to Burdeus and Anibawan Bays, on Polillo Island.

Two launches were used in the development of the inshore hydrography and the different anchorages; also the area between Polillo and Patnanongan Islands was surveyed by launch parties with the result that three ship channels were developed leading into Burdeus Bay from the southward.

An automatic tide gauge was installed in Burdeus Bay and a continuous record of two and one-half months was obtained.

[J. W. MAUPIN, Commanding Steamer *Fathomer*.]

**SUMMARY OF RESULTS.**—Triangulation: 177.9 square miles of area covered, 19 signal poles erected, 14 stations in main scheme occupied for horizontal measures, 20 geographic positions determined. Levelling: 9 permanent bench marks established. Magnetic work: ship swung at 1 station at sea. Topography: 61.6 square miles of area surveyed, 143.8 miles of general shore line surveyed, 8 miles of shore line of rivers surveyed, 5 topographic sheets finished, scale 1:20,000. Hydrography: 941.9 square miles of area covered, 7,179.5 miles run while sounding, 30,137 positions determined (double angles), 82,674 soundings made, 4 tide stations established, 2 current stations occupied, 4 hydrographic sheets finished, scale 1:20,000. Physical hydrography: 418.4 miles run in deep-sea sounding, 149 deep-sea soundings made, 2,080 square miles covered in deep-sea sounding.

At the beginning of the fiscal year the steamer *Fathomer* was undergoing general repairs at Manila, which were completed September 10. On September 11 the vessel sailed from Manila to take up general surveys on the north coast of Busuanga Island. The *Fathomer* arrived at Busuanga Island on the following day, and a temporary anchorage was made in Port Caltom. The next day a small but good anchorage, sheltered from all weather and centrally located for the work, was discovered in the mouth of the Pangauran River, and the vessel was shifted to this anchorage. This harbor was made the headquarters for the ship during the entire season. A tide gauge was established in the Pangauran anchorage and used for all the work on the north coast of Busuanga Island.

The weather during the first half of the fiscal year was unfavorable for work on this coast. The season's work was opened during the height of the typhoon season, and a number of typhoons passed while the work was in progress, the severest of which blew from September 23 to 26.

The north coast of Busuanga is open to the China Sea and the effect of every blow was marked by a heavy swell. At the end of the typhoon season the northeast monsoon set in and blew with more or less regularity during the rest of the year. Landing was very difficult, and some of the hydrographic signals had to be made by throwing buckets of whitewash against the cliffs from pulling boats.

Owing to the heavy weather and a lack of outside anchorages, the vessel had to make the Pangauran anchorage every night, and during the latter part of this period a run of about 20 miles to and from the working grounds had to be made.

A camp and launch headquarters were established at the Barrio of Calait during the latter part of this period, and by using the estuary to cross over to the west coast of Busuanga Island, this proved to be on a very convenient point. Camping parties for topography and hydrography were always left either here or at the Pangauran anchorage when the vessel went for coal.

By the end of December the triangulation, topography, and hydrography on the north coast of Busuanga Island were nearly completed, and it was planned to shift the headquarters of the party around to the west coast.

At the beginning of January the *Fathomer* was engaged upon general surveys on the north coast of Busuanga Island with headquarters at the mouth of Pangauran River in Port Caltom. Throughout the season Manila was used as the coaling station, and this vessel had to make a run of approximately 400 miles for coal every three weeks. Lines of deep-sea soundings were usually carried about half-way to and from Manila while running for coal, and camping parties were nearly always left on the working grounds.

The northeast monsoon, with increasing strength, made work very difficult on the north coast of Busuanga, and after the semiannual repairs were completed on March 19, it was considered advisable to shift headquarters from the north to the west coast of Busuanga Island. A new anchorage was selected and tide gauge established at Malbinchilso Island which is the farthest anchorage to the westward and nearest the working grounds. This anchorage was used to carry the work about halfway up the west coast of Busuanga Island. Another small but well protected anchorage, which is not shown on the old chart, was discovered and surveyed during the early part of the season on the northwest end of Busuanga Island, locally called Illultuk Bay by the natives. The *Fathomer* shifted headquarters to this bay on May 12, and established a camp and tide gauge. This anchorage is the nearest point to the remainder of the work and was used till the end of the period of this report.

The topography of Busuanga and outlying islands was entirely completed by this vessel, and this completes the topography of the entire Calamianes Group. The hydrography is also nearing a state of completion. The 5,011.7 miles of soundings were done in approximately four months. It will be noted that the development is comparatively close from the number of soundings, 54,817, taken in an area of 710 square miles (this does not include deep water soundings 5 miles apart). Approximately 30 off-lying shoals were discovered and developed. One of these shoals is 13 miles long and



covers an area of 12 square miles. Another is 4 miles long and covers an area of 7 square miles. A third covers an area of 4 square miles.

[A. M. SOBIEBIALSKI, Commanding Steamer *Marinduque*.]

**SUMMARY OF RESULTS.**—Reconnaissance: Length of scheme 16 miles, 157 square miles of area covered, 5 lines of intervisibility determined as per sketch submitted, 3 points selected for scheme. Triangulation: 878.6 square miles of area covered, 53 signal poles erected, 23 stations in main scheme occupied for horizontal measures, 7 stations in supplemental schemes occupied for horizontal measures, 13 stations occupied for vertical measures, 63 geographic positions determined, 35 elevations determined trigonometrically. Magnetic work: 2 land stations occupied for magnetic declination. Topography: 82.8 square miles of area surveyed, 43.5 miles of general coast line surveyed, 15.8 miles of shore line of rivers surveyed, 5 miles of roads surveyed, 2 topographic sheets finished, scale 1:20,000. Hydrography: 726.6 square miles of area covered, 4,171.5 miles run while sounding, 15,100 positions determined (double angles), 72,989 soundings made, 4 tide stations established, 6 current stations occupied, 7 hydrographic sheets finished, scales 1:80,000, 1:40,000, and 1:20,000.

Up to July 1, 1916, the party on the steamer *Marinduque* had been chiefly engaged on the main scheme triangulation of Palawan Island, but although most of the signals had been built, very little observing had been done.

The ship arrived at Buena Vista, 250 miles from a coaling station, with only 37 tons of coal and about two weeks' work to do. However, the conditions proving favorable, the work on the west coast was completed as planned, and the ship returned to Puerto Princesa with a ton of coal to spare.

The remaining stations in the main scheme, with the exception of Mount Peel, were reached from the east coast. Mount Peel was occupied by a party which crossed the Baheli portage. Thumb Peak was afterwards occupied.

On August 5 the ship arrived at Manila for transfer of officers. Two parties had been left in the field engaged on triangulation, one at Cleopatra and one at Mount Peel.

Up to this time all the efforts of the party had been devoted to the triangulation so that very little hydrography had been completed. It was now necessary to prosecute the offshore hydrography in order to complete the development of Pasig Shoal before the good weather should end. One party, however, was continuously engaged on the triangulation, and not until October 21 were the observations finally completed.

As a result of the season's work, a strong main scheme was extended to the line Thumb Peak-Table Head, more than halfway down the island. A well-determined line for the extension of local schemes was established in Puerto Princesa and Honda Bay, while in Ulugan Bay two intersection stations were located. Supplementary stations were located between Bold Point and Fondeado Island, so as to give the topographer some check along this coast where a local scheme is not feasible. The local scheme from Dumaran Island to Bold Point was connected to the main scheme on the line Escarpado-Stripe Peak. Numerous intersection stations were located, practically every island on the west coast within the limits of

the work and every peak of any prominence being located by three or more cuts. The reconnoissance was made for an additional figure. As the triangulation became sufficiently advanced the hydrography was taken up. The ship work in Green Island Bay was extended offshore with the object of defining the limits of launch work on Pasig Shoal.

By the end of October the hydrography had been extended out to the 100-fathom curve and Pasig Shoal developed. The triangulation then being completed, three hydrographic parties and a topographic party were kept in operation until December 15, when the season closed and the ship returned to Manila.

With the exception of a few small areas, the hydrography of Green Island Bay out to the 100-fathom curve was then completed.

In Honda Bay numerous reconnoissance lines were run.

On the way to Manila the inshore hydrography and topography of Cambari Island and a small patch of topography in Dumaran Channel were completed.

A number of uncharted reefs and shoals were discovered and reported.

One topographic sheet was completed from Bold Point to Emmit Point. This was straight traverse work with one triangulation station for a check at about the middle of the sheet.

Current observations were taken on the outside reefs.

Two stations were occupied for magnetic declination.

An automatic tide gauge was kept in operation continuously at Puerto Princesa, and a tide staff at Tinitian while hydrography was in progress.

At the beginning of the calendar year the ship was at Manila, repairing and outfitting. An Eckliff automatic boiler circulator was installed. Its action is very satisfactory.

On February 10 the ship left Manila, arriving on the working grounds on the east coast of Palawan two days later. The northeast monsoon was still blowing so strong that work could be prosecuted only in sheltered places. A party was therefore left at Green Island to complete the inshore hydrography, while two parties were left in Honda Bay to extend the tertiary triangulation and the topography in that vicinity.

Owing to the exhaustion of the coal supply at Puerto Princesa, the ship had to run to Coron for coal, a distance of 190 miles.

When the inshore hydrography in Green Island Bay was completed, two hydrographic parties and a topographic party began work in Honda Bay while the ship worked in Green Island Bay. Early in April this work was completed, and the ship returned to Manila for cleaning boilers and for supplies, leaving one party in Honda Bay.

On account of the extremely high price of coal it became necessary to exercise the utmost economy in coal consumption. Most of the time of the party for the rest of the season was therefore devoted to extending the main scheme triangulation.

The results of the season's work are as follows:

The hydrography of Green Island Bay out to the 100-fathom curve is finally completed.

In Honda Bay the inshore hydrography from Pasco Point to Addison Point is completed, including all the area between the

islands and the mainland and extending from 2 to 5 miles to the southward of the island.

Some reconnoissance lines of soundings were run as far as Separation Point in connection with the triangulation. No dangerous reefs were discovered.

Some reconnoissance work was done in Puerto Princesa to investigate a report of errors in the existing chart.

Several dangerous uncharted reefs in Honda Bay were located.

The hydrography of Green Island and Honda Bays reveals a very peculiar formation. Jutting out from the shore are long projections with moderate depths (about 30 fathoms) terminating in reefs like the inclosing reefs of an atoll, with stupendous slopes on the outside, often dropping from 3 to 700 fathoms within a mile. This same formation seems to extend down the Palawan coast. From a study of this formation the conclusion was drawn that the most dangerous reefs occur close to the 100-fathom curve, excepting, of course, those that occur close to shore. In navigating the unsurveyed waters to the southward of Puerto Princesa, this theory has been found useful, for one can almost predict where shoal water will be found. Similarly, in executing the hydrography, the work can be better planned when knowing where to expect shoal water. Another conclusion is that it is better to travel inside of the 100-fathom curve than outside, for the reefs are very steep-to on the outside and give no warning, and besides, the currents are stronger on the outside and are very irregular, being influenced by these various projections.

The completion of the survey of Green Island Bay shows a channel which, with a few aids, could be used by vessels bound to Manila, affording good shelter from the northeast monsoon from Green Island to Coron. Most of the traffic to Palawan consists of small steamers and sailing vessels towed by launches. During the strength of the monsoon these vessels often have to seek shelter. Several ship captains were consulted about the possibilities of this route—i. e., north of Johnson Island, north of Green Island, through Dumarman Channel, then in the lee of the islands off the east coast of Palawan—and they all said they would use it if a few lights were installed to make it navigable at night. The *Marinduque* found occasion to use this route on one of the trips to Coron, the weather being so bad that no progress could be made outside.

In connection with the ship hydrography a trolley system with hand lead was used for all depths up to 30 fathoms. A drum was attached to the Lucas sounding machine by means of an additional shaft, driven by a handmade geared pulley. This does away with the arduous labor of hauling in the lead line by hand, reduces the time required to haul it in, and makes it possible to use heavier leads. By using two lead lines, sounding with one while the other is being hove in, soundings up to 30 fathoms can be obtained in one-minute intervals with the ship making 5 knots. Three men can handle the operation. Soundings with the Tanner-Blish tubes can be obtained faster, or just as fast with a greater speed, and require the same number of men, but the increased accuracy and reliability of the soundings certainly offsets this slight advantage. All the appliances—the trolley, drum, geared drive, etc.—were made aboard by hand out of materials on hand.

One station was occupied in Green Island Bay for current observations, and another off Arena Island, the latter being occupied for  $6\frac{1}{2}$  days. Nothing of interest was developed, the currents being weak and irregular.

The automatic tide gauge at Puerto Princesa was continued in operation, and tide staffs were maintained at Tinitian and Babuyan while hydrography was in progress. There were evidences at Arena Island that the seiches, which are so marked at Puerto Princesa, occur in this vicinity as well, for a reef was noticed to bare and cover and bare again within a few hours. No observations, however, were taken.

One topographic sheet, Honda Bay from Pasco Point to Addison Point including the offshore islands, was completed. The Babuyan, Tandayak, and Tapul Rivers were traversed to the first rapids, and the Tapul-Baheli portage was traversed to the limits of the sheet.

The reconnoissance and signal building for the main scheme triangulation were extended from the line Thumb Peak-Table Head to the lines Albion Head-Aboaba-Tagalinog Island.

Three of the stations were occupied including the most difficult of all, Victoria, 5,680 feet high. It took eight days to reach this peak. Afterwards Cleopatra (5,200 feet), Stripe Peak (4,800 feet), and Mount Peel (3,600 feet) were occupied. Of the other stations in the scheme, only Anepahan and Central are difficult to reach. Albion Head was reached by the portage from Separation Point.

Tagbanua guides and cargadores obtained at various points along the coast were used on all the trips to the mountains, a party consisting of from 6 to 11 men, depending on the length of the trip.

At Aborlan, the Government maintains a reservation where these natives may attend school and get practical teaching in agriculture, etc. The natives here speak English better and more generally than anywhere along this coast, not excluding Puerto Princesa.

A 42-foot observing scaffold was built at Arena Island. Supplementary stations were built at Inagauan, Malanao Island, Emelina Island, and Crawford Cove.

The reconnoissance was made very difficult by the fact that Victoria Peak is surrounded by flat ranges from 3,000 to 5,000 feet high. All the lines radiating from Victoria pass very close to obstructing peaks, so that a slight variation in the location of any of the stations would make the scheme fail. To add to the difficulties, Victoria shows out of the clouds only at rare intervals, usually very early in the morning.

Besides the main scheme triangulation, the local scheme in Honda Bay was extended to furnish control for the topography, and the signals were built and some observing done on the local scheme in Puerto Princesa.

The northeast monsoon continued very strong until March 20, but after that date it was not as strong as last year, when it continued till April 15. After that date the weather was generally good. Early in May there were 10 days of very unusual haze, which caused fear among the natives. It was impossible to learn the cause of it.

Up to April, Port Uson was used as a coaling station. After May 1, coal was obtained at Manila.

[R. R. LUKENS, Commanding Steamer *Romblon*.]

Triangulation: 360 square miles of area covered, 41 signal poles erected, 1 observing scaffold and tripod built, height 110 feet, 25 stations occupied for horizontal measures, 6 stations occupied for vertical measures, 41 geographic positions determined, 6 bench marks established. Topography: 100 square miles of area surveyed, 101.9 miles of coast line surveyed, 3 topographic sheets finished, scale 1:20,000. Hydrography: 1,251 square miles, 6,963.5 miles run while sounding, 84,356 soundings made, 5 tidal stations established, 2 current stations occupied, 14 hydrographic sheets finished, scales 1:100,000, 1:40,000, 1:20,000, and 1:10,000.

On July 1, 1916, the steamer *Romblon* was at Manila obtaining supplies and outfitting. On July 12 the steamer sailed for the Cuyo Islands arriving off Quinaluban Island the following evening. On the morning of July 14 a launch hydrographic party was put in camp with instructions to complete the inshore hydrography of that group.

The ship then proceeded to the southward and took up work on a sheet covering a large gap in the existing work in the vicinity of Matarabis and Tabubuc Islands. This work was continued under favorable weather conditions until the evening of July 28, when the vessel proceeded to Iloilo for coal, arriving there the following morning.

On August 1 the *Romblon* sailed from Iloilo for Manila via the Cuyo Islands where the camp party was picked up, and arrived at Manila on August 3.

The vessel was undergoing extensive repairs at Manila until September 19 when she again sailed for the Cuyo Islands, arriving on the following evening. A launch hydrographic party was put in camp at Manamoc Island and remained there until October 1. The ship again took up the work where it had been discontinued, but was delayed three days by a typhoon passing to the north.

While coaling ship at Iloilo on October 30 instructions were received calling for some additional hydrographic work off the town of San Jose de Buena Vista, west coast of Panay. The *Romblon* arrived off San Jose at noon on October 31, and work was started at once. The survey was finished the next day, and the *Romblon* left for the Cuyo Islands at 12.30 a. m., November 2.

The hydrographic work included many small gaps to be filled, many split lines and a considerable area of new work. Work on the shoal development, inshore hydrography and filling small gaps was taken up first, in order to take advantage of good weather. The launch was used for the inshore hydrography of all islands and also for the development of small offshore shoals and banks.

Search was made for a rock reported by the British ship *Belted Bill* about 7 miles southeast of Agutaya Island. About 1 square mile was dragged with an 1,800-foot drag set to 36 feet in the reported position of the rock, but nothing was found in the area examined.

A shoal with a least depth of 17 feet was discovered about 5 miles southwest of Lubic Island. This shoal is reported to be near the track taken by some large ships, which come through the Sulu Sea in order to avoid the heavy northeast monsoon in the China Sea, while en route to the China coast.

No systematic current observations were made during the work, but experience in running sounding lines showed that there existed a

southwesterly set during the northeast monsoon and a northeasterly set during the southwest monsoon. This set is variable in direction and force, being deflected and at times reversed by the tidal currents. Narrow belts of currents have also been noted, so that the question of currents seems to be a very complicated one for this area.

The only triangulation done was the location of a station on Tabac Rock. The line Patunga-Lean was used as a base and all three angles were observed.

No general topography was done. In a few cases the planetable was used to locate hydrographic signals where the previous points could not be recovered.

During the survey of the Quinaluban and Manamoc groups a tide staff at Quinaluban Island was read. This staff was referred to the datum determined in previous years. The differences in time and range over the area surveyed seem to be very small.

The whole season was unusually free from storms.

On December 19 the work was finished and the vessel proceeded to Manila via Coron, arriving on December 22.

On January 1, 1917, the steamer *Romblon* was in Manila undergoing minor repairs at the insular repair yard on Engineer Island. The party was engaged on annual inventories and in getting supplies for the coming season's work around the southern end of Palawan Island. Formal instructions for this work were received on January 11, but before sailing it was necessary to await the arrival of the steamer *Pathfinder* in order to arrange limits of sheets and other details in regard to taking up the work to the northward of the *Pathfinder's* assignment. By Saturday, January 13, all necessary data had been received, and on Monday morning the *Romblon* sailed for the working grounds via Puerto Princesa.

The vessel arrived at Puerto Princesa on the afternoon of the 17th and the next day was spent in coaling and watering the ship. At noon on the 19th the *Romblon* sailed for southern Palawan, choosing a route well out on the Sulu Sea. Numerous reefs have been reported in that area so the sounding machine was kept going most of the time, letting out 90 fathoms of wire each time. In no case was bottom reached until well in toward Bugsuk Island. The boat sheets of the *Pathfinder* were successfully used in navigating the ship through the intricate channels between the islands, and on the afternoon of the 20th the *Romblon* anchored off Bancalan Island. The crew on going ashore the following day to visit an American lumber camp found three American soldiers who had come ashore in a banca, having been blown away from Corregidor Island two weeks before. These soldiers had landed on Cabra Island, and in a calm started back for Corregidor only to have the wind come up and sweep them out to sea again. Their next landing was apparently on Busuanga Island. There they got some water but were unable to approach the natives, who took to their heels at the first sight of them. These unfortunates then coasted down Palawan Island missing Busuanga Strait, and because of high seas were unable to land until Bancalan Island was reached; and there they managed to get their craft behind the reef, and landed very close to the lumber camp. In a few days they were able to return to Manila in a steamer which tows schooners loaded with logs.

On Monday morning, January 22, the *Romblon* took up anchorage off Dalagican Island, and the work of signal building, triangulation, topography, and hydrography was taken up in the order given. The launch worked on the inshore while the ship took up the offshore work. The bottom here is uneven and invisible so that very close work was required to avoid missing any shoals. The weather was favorable and rapid progress was made until February 13, when it was necessary to go to Puerto Princesa for coal. Owing to the unhealthfulness of the country and the absolute lack of camping sites near the work, none of the parties was left behind when the ship left for coal. The vessel arrived at Puerto Princesa at 8:45 p. m., February 14, and took up anchorage off the wharf.

Coaling operations were begun the following day, but the ship was not filled up until the afternoon of February 17.

At noon on the 19th the *Romblon* sailed for the working grounds, and arrived there the following evening.

Topography, triangulation, and hydrography were continued up the east coast of Palawan, the ship maintaining anchorages near the center of the work. The work was much hampered by the persistent northeast monsoon which was blowing at the time. As the vessel is equipped with only one launch, a good deal of running had to be done with the ship itself in order to keep signals ahead of the hydrographic party, and subsequent surveys show that the vessel passed very close to several dangers that were not visible.

The work of repairing and overhauling by the crew was continued while in Manila, and on April 14 the *Romblon* sailed for Palawan, arriving there on April 17.

By that time the weather had become fine and work on reconnaissance for the main scheme triangulation was at once taken up. A launch-hydrographic party was put in camp on Arrecife Island and continued the hydrography of Coral Bay, while the ship took up hydrography and moved parties around for signal building and reconnaissance.

On April 30, the *Romblon* started for Sandakan, British North Borneo for coal, and arrived there the next afternoon. Arrangements were made with the Cowie Harbour Coal Co. (Ltd.), and the vessel was coaled with considerable dispatch.

Upon the return to the working grounds work was continued as before, with special effort put on the triangulation. The hazy weather which had obscured the peaks for some time now disappeared and the reconnaissance for three figures extending to Brooks Point was soon completed. This included stations on Bulanjao Range, and on Mount Mantalagajan, 3,500 and 6,800 feet, respectively. The first ascent was made on Bulanjao, and much difficulty was encountered both in finding the proper route and in getting cargadores. The coast line is peopled by Moros who are in general a lazy and shiftless lot, and it is only at the command of their headmen that they will go with a party and then they are slow and arbitrary about the work.

Datto Batarasa, at Bonabona, procured cargadores for the first attempt which was routed by way of the Iwahig River, a route recommended by the datto himself, but after traveling for four days,

the Moros refused to go farther; and the party was forced to return to Bonabona, where it was picked up by the ship.

It was then decided to make up a party including one officer and five men from the ship and try a route up the Sumbiling River. This trip was successful, four tagbanuas were induced to accompany the party, and with this help they reached the top in three and one-half days. The slopes of this mountain are covered by thick undergrowth and every step of the trail had to be cut through with bolos.

Fortunately, the weather cleared for sufficient time and the required observations were made. Altogether, the party was in the hills 14 days. It must be remembered that this country is very wild and there are no trails or communication whatever, and even the wild natives are only familiar with the immediate vicinity in which they live.

The triangulation scheme included one high signal at Tami Point. About nine days were consumed in clearing and building the scaffold. The signal is about 110 feet high, and a tree is used as instrument support.

The establishing of a station on Mount Mantalagajan and the occupation of the same was assigned to a subparty. This party consisted of the best 2 sailors on the ship and 11 wild tagbanuas, one of whom, their "Capitan" or head man, had charge of them. It took the party nine days to reach the top. Part of the time they were short of water and consequently unable to cook rice. In fact, they had to depend almost entirely on rain water and pitcher plants for their water supply after they reached the 3,000-foot elevation. At the top, where they remained three days, the party suffered much from the intense cold. Three days more were consumed on the return trip, making a total of 15 days for the expedition, which was a success in every way.

At the close of the fiscal year, signals had been built for three figures of the secondary triangulation, and six stations had been occupied, including the base stations.

The launch was kept at inshore hydrography continuously, working from camps on Arrecife Island, Bowen Island, and Bonabona.

The ship took up offshore work when possible. A great deal of time was required for shifting parties for the triangulation and reconnoissance, so that the mileage made by the vessel is small as compared with the previous season.

The area covered is very full of reefs and shoals, making the work both tedious and difficult. With a good light overhead, these shoals can always be seen, but when running toward the sun it is a very different proposition, and the vessel is in constant danger of striking.

Topography was completed from Capiyas Island on the west coast to Iglesia Point on the east coast. Most of the shore line is covered with mangroves, and the work was difficult. The parties worked in waist-deep water nearly all of the time, and at times it was necessary to hold the table down by force. All the streams of any size were traversed by launch or pulling boat using estimated speed and compass courses. All topography was closely controlled by triangulation.

Sandakan, British North Borneo, was the headquarters for the party during the last half of the season. It is about 180 miles dis-



tant from the working grounds. All kinds of provisions are procurable there, and coal can be purchased at present for 30 shillings per ton. It takes about three and one-half hours to coal the *Romblon*. Water is furnished free by the Government and runs at the rate of about 8 tons per hour, while ice can be purchased at \$25 per ton Borneo currency, with a rate of exchange (\$1=1.175 pesos). Ships laundry can be done in one and one-half days, at the rate of 5 cents per piece. There are two wharves there, one belonging to the coal company, and the other to the Government, which is the North Borneo Co. This company has a concession from each of the various sultans, and operates the Government as a British protectorate. No one can have absolute title to land, but it can be leased for 999 years. The resources of the country are slowly being developed. The interior of the country is very wild and abounds in big game, including elephants. The elephants scratch their backs on the telegraph poles, which causes the company a great deal of trouble. This country is also the home of the "Orang Utang," the English translation of which is the "Wild man of Borneo," which recalls our youthful circus days.

In ordinary times a steamer from Manila makes monthly trips to the Palawan coast, going as far as Brooks Point, but that steamer has been withdrawn and there is now only a hit-and-miss communication with Manila, and most of this irregular service is furnished by the two Coast Survey vessels which operate along the Palawan coast. All mail for this party was received from Puerto Princesa in native boats and launches.

[O. W. SWAINSON, Commanding Steamer *Research*.]

**SUMMARY OF RESULTS.**—Triangulation: 3.5 square miles of area covered, 3 signal poles erected, 1 station in supplemental scheme occupied for horizontal measures, 3 stations occupied for vertical measures, 3 geographic positions determined. Topography: 2 topographic sheets finished, scale, 1:20,000. (These topographic sheets were for the purpose of locating hydrographic signals and not shore line.) Hydrography: 196 square miles of area covered, 1,244 miles run while sounding, 4,423 positions determined (double angles), 20,379 soundings made, 1 tide station established, 2 current stations occupied, 2 hydrographic sheets finished, scales, 1:20,000 and 1:40,000.

From July 1 to August 9 the steamer *Research* was undergoing annual repairs at Manila.

On August 15 the vessel sailed for Iloilo, arriving on the 17th. The following day was spent in repairing signals, which had been erected in May, and building and locating others. The hydrography of Iloilo Strait was then begun with launch and ship and continued every day when the weather permitted.

Signals were placed from 100 to 300 meters apart along both the Panay and Guimaras coasts. They were located by planetable traverse and triangulation. The traverse and triangulation were controlled by recovered triangulation stations on Guimaras Island and church spires on Panay Island.

From Iloilo to the southern end of Oton Bank the sounding lines were spaced 100 meters apart and the soundings on these lines were spaced from 20 to 100 meters apart. The hand lead was used up to

8 fathoms in depth; at greater depths soundings were taken with a hand sounding machine.

The positions of all aids to navigation were determined by sextant angles.

Current observations in the south channel were made during 59 hours beginning at 8 a. m., August 28, and ending at 6 p. m., August 30. The maximum velocity of current observed in the south channel was 2.2 knots.

Current observations in the north channel were begun on October 9 at 6 p. m. and continued until 6 a. m., October 12. A maximum of 2 knots was observed there.

The current is about 1 knot stronger off Bondulan Point, and from there past the mouth of the Iloilo River. No observations were made in this part of the straits.

A tide staff was fastened to the inside face of the quartermaster's dock and connected by leveling with permanent bench marks at the beginning and close of the hydrography. Readings were made on this staff every 20 minutes while hydrographic work was being done and every 20 minutes night and day while current observations were being made.

No attempt was made to determine the shore line further than to sketch it in where the old work was considerably in error.

A search was made for a shoal reported in latitude  $12^{\circ} 33'$  and longitude  $122^{\circ} 23'$ , and an area of 2 miles square surrounding this position was carefully sounded over. Uniform depths of 200 to 390 fathoms were found with no indication of a shoal. A new light on Nogas Island, south end of Panay, was located and its arc of visibility determined.

A new triangulation station was established on the northeastern side of Nogas Island in the vicinity of the unrecovered station Ani.

The work in Iloilo Strait was completed on October 12.

[EOLINE R. HAND, Commanding Steamer *Research*.]

**SUMMARY OF RESULTS.**—Reconnaissance: Length of scheme 14 miles, 177 square miles of area covered, 11 lines of intervisibility determined as per sketch submitted, 6 points selected for scheme. Triangulation: 440 square miles of area covered, 3 signal poles erected, 5 scaffolds and signals built, heights 40 to 55 feet, 6 stations occupied for horizontal measures, 12 stations occupied for vertical measures, 18 geographic positions determined, 18 bench marks established. Topography: 47.5 square miles of area surveyed, 85.3 miles of general coast line surveyed, 81 miles of shore line of creeks surveyed, 4 miles of roads surveyed, 4 topographic sheets finished, scale 1:20,000. Hydrography: 697 square miles of area covered, 5,855 miles run while sounding, 27,387 positions determined (double angles), 99,758 soundings made, 6 hydrographic sheets finished, scale 1:20,000 and 1:40,000.

On October 18, when the charge of the vessel was transferred, the steamer *Research* was at Manila taking on supplies and undergoing slight repairs.

On October 23 the vessel left the harbor with instructions to make a general survey of Manila Bay.

It being deemed advisable to begin operations at the entrance and proceed north along the west, or Batan coast, the survey was begun in the waters surrounding Corregidor and Caballo Islands, effecting

a junction with hydrography previously executed by the Coast and Geodetic Survey and thus extending the sounding out of both the North Channel and the South Channel into Manila Bay.

When the unsurveyed portions about the entrance to the bay were completed the hydrography was continued northeastward from the channel islands to a line drawn northwest from San Nicolas Shoals beacon and then north to Pampanga Bay, covering all of the area west of longitude  $120^{\circ} 41'$ . The topography was begun at a point near station Limay, at the end of a sheet begun the year before, and carried north to Pampanga Bay. There are accurate maps of this shore, so no interior detail was drawn beyond that necessary to properly connect with them. The triangulation consisted of reconnaissance only. A scheme was selected, resting on the base Orion-Malabon, to control the north end of the bay, and the necessary signals were erected.

Existing triangulation furnished sufficient control for the topography and hydrography.

A graphic location with the planetable was made of a large signal (Api) erected on the shore, which will be one of the occupied stations of the triangulation.

A comparison of the soundings made with those on the published charts indicates that the bottom in the entrance has become more uniform. Farther north the soundings are in general 2 fathoms greater than on the charts, except near Pampanga Bay, where there is but a slight difference. Shoal water does not extend as far off the west shore as the old soundings represent.

The charted shore line of the Pasag River was found to be considerably out of position to the northwest.

On January 1, 1917, the steamer *Research* was engaged in a general survey of Manila Bay. The operations in the bay were continuous after that time. New triangulation was thrown over the hitherto uncontrolled north half and extended up to the navigable Pasag and Orani Rivers, the shore line was run around it, and the included waters closely sounded, so that the end of the fiscal year views the practical completion of the work called for by instructions. There remained, on June 30, 55 square miles of undeveloped area in the center of the bay, and a week's work each of topography and hydrography up the above-mentioned streams.

Starting from the base Orion-Malabon C. D. (an east and west line that spans the bay) a quadrilateral was determined whose opposite side rested upon the north shore, and from the stations of this figure such intersection points were selected as would best check the topographic sheets, and in addition serve effectually as signals for ship soundings.

From the line Orion-Api two figures were extended north to control Pampanga Bay and also the Pasag and Orani Rivers which empty into it. Because these streams are used by steamers as far as Guagua, it was intended to carry the topography and hydrography up each river to that town.

The country triangulated being low and swampy, scaffolds from 40 to 55 feet were a necessity, and difficulty was experienced in find-

ing ground in the required positions sufficiently solid for their erection; then, to insure stability, scantlings had to be driven to serve as piling. A type of mark was adopted to suit the marshy nature of this ground.

The topography was continued from a point on the west side of Pampanga Bay and executed in detail eastward around the shore to Malabon C. D., where it joined old work. From here southward to Paranaque, and southwest from Sangley Point, the shore line only was run for the purpose of locating hydrographic signals.

This north shore is chiefly a succession of river mouths, with nipa swamps and fishponds between. These rivers are all joined into a most intricate system, so that one may pass by boat in almost any direction; indeed, it is possible, though not practicable, to proceed by launch from Manila to Orani across on the west shore without going into the bay at all. The delineation of the shore, drawn sufficiently wide to provide an ample topographic fringe when reduced to chart scale, usually includes the first of these negotiable passages between mouths. The watercourses among the swamps and fishponds were surveyed, not sketched, and this offers a firm foundation for the building on of interior work from other sources. The fishponds are areas of cleared swamp dyked off from the streams and connected with them at intervals by elaborate concrete gates. Where the ponds come down to the bay shore, the dykes are protected against erosion by strips of mangrove carefully cultivated and guarded.

The topography was finished and the sheets turned in, excepting a short piece of mapping up the Orani and Pasag Rivers, purposely left to the last.

The ship hydrography was continued over the remaining unsounded portion of the bay (east of  $120^{\circ} 41'$  and south to San Nicholas Shoals) with 200-meter lines, which are being opened up to 250 meters in the center. No change was found in the remarkably even bottom previously reported, and it was invariably mud, except in the proximity of the shoals. The north part is very shallow, which forced the ship to anchor 2 and 3 miles offshore to the great inconvenience of the parties sent out. The launch carried the sounding in from the ship limits to low water, keeping a consistent relation between the width of line and the importance of the locality. Pampanga Bay (more appropriately Pampanga Flats) was developed, and the channels through it of the Pasig and Orani Rivers. In connection with the development off the north shore, those streams that led to the marsh villages, or appeared to offer a feasible power-boat route to the big towns inside, were sounded to the limit of the topography, stopping preferably at a fork. None of them is used regularly by launches, for the Manila Railway serves effectually all that north bay country above the swamps.

The river at Malabon was sounded to the shipyards of the Yangco Steamship Co., close work was done off the Pasig River mouth and the Manila breakwater, the channel buoys were located, and the survey was extended behind the breakwater up to the limit of dredging operations.

## SPECIAL DUTY.

## MASSACHUSETTS.

## RELOCATION OF TRIAL COURSE FOR SUBMARINES AT PROVINCETOWN, MASS.

[H. P. RITTER.]

In accordance with a request from the Navy Department arrangements were made at the end of July, 1916, for the inspection at Quincy, Mass., of four beacons constructed for end ranges of the submarine torpedo-boat trial course of Provincetown, Mass., and afterwards for the relocation of the ranges and the supervision and inspection of the work of location and construction of the foundations for the beacons.

The officer assigned to this duty arrived in Boston on the afternoon of July 27, and on the 28th proceeded to the works of the Fore River Shipbuilding Corporation at Quincy and inspected the 4 beacons and the 12 forms for the concrete piers, which were found to have been satisfactorily completed.

On the morning of the 29th the observer returned to Boston and on the following morning proceeded to Provincetown.

It being the desire of the Navy Department to have the ranges more to the westward (about one-eighth of a mile) so that the eastern range beacons would be clear of the sand dune and the Long Point Lighthouse buildings, a preliminary inspection and survey were made to ascertain just how much the ranges could be shifted and preserve the best range location for each end of the mile.

It was found that by shifting the ranges 600 feet to the westward, the eastern range would be clear of the above-mentioned obstructions, and the range defining the western end of the measured mile would be clear of the buildings of the Wood End Coast Guard station.

Afterwards, the old ranges Nos. 1 and 5 were checked by means of the triangulation stations and other points used in the verification of 1909 and 1915 and the new ranges laid out parallel to and 600 feet to the westward of the old ranges.

A profile of the surface of the ground of each range was then made and the location of each one of the four range beacons determined.

Stakes were set for the center of each range beacon and its three concrete piers.

The work of placing the concrete piers and the erection of the beacons by the contractors was supervised during construction by the officer assigned to this duty and verified after completion.

New quarter, half, and three-quarter mile ranges were also determined.

Front and rear targets were placed on the half-mile range, and range stakes on the quarter and three-quarter mile ranges.

EXHIBIT OF THE COAST AND GEODETIC SURVEY AT THE MEETING OF THE NATIONAL ACADEMY OF SCIENCES.

[R. F. LUCE.]

On the afternoon and evening of November 13 an exhibit illustrative of the work and methods of the United States Coast and

Geodetic Survey was made at the meeting of the National Academy of Sciences in the buildings of the Massachusetts Institute of Technology at Boston.

The exhibit was most successful in calling attention to the activities of the Survey.

The scientific members of the society and visitors manifested much interest in the material shown and made a number of useful suggestions for improving the charts and nautical publications.

#### EXPERIMENTAL WORK TO TEST THE ACCURACY OF THE WIRE DRAG.

[N. H. HECK.]

During the season of 1916 some interesting experimental work was done by N. H. Heck to test the accuracy of the wire drag.

These experiments were necessarily made on land as the actual operation of the drag beneath the surface of the water can not be observed by any means available.

The primary object of these experiments was to discover under what conditions it is possible for the drag wire to slide over the top of a smooth bowlder at a depth less than the effective depth of the drag without being noticed.

The liability of the drag to slide over an obstruction is of course dependent largely upon the slope of the obstruction and whether its surface is rough or smooth and also upon the depth to which the drag is set as compared to that of the obstruction.

The actual conditions of wire-drag work were of course not obtained in these experiments, but it was assumed that, no matter how the wire is brought in contact with the rock, it will act in a similar manner.

It is found that there is little danger of the drag failing to hold when the rock has projections and that the wire will hold at a slope of about 25° or more. At a less slope the action of the wire is uncertain.

Marine growth has a tendency to hold the wire.

With a heavy swell the tendency of the drag to slide over an obstruction is increased.

NEW YORK.

#### EXHIBIT OF COAST AND GEODETIC SURVEY AT NATIONAL MOTOR BOAT SHOW AND AT PAN AMERICAN AERONAUTIC EXPOSITION.

[L. A. POTTER.]

An exhibit illustrating the activities of the Coast and Geodetic Survey was made at the Thirteenth Annual Motor Boat Show held at the Grand Central Palace, New York City, from January 27 to February 3, inclusive.

The space assigned to the Coast and Geodetic Survey was on the second floor of the building near the Lexington Avenue side and in a very desirable location.

Charts, photographs, and sketches were displayed at the back of the space and on the front of the counters, and miscellaneous publications on the counters. Two movable tables were provided, one for the display of the instruments and one for the spare charts not on the walls.

The exhibit was made up as follows:

*Charts.*—About 100 charts, including all of the sailing and general charts of the Atlantic coast; the 1:80,000 scale charts from Maine to South Carolina; the harbor charts from the eastern end of Long Island Sound to Delaware Bay entrance; and the general charts covering the Pacific coast, Porto Rico, Hawaii, and the Philippines. About 20 charts were displayed on the space at the back and the remainder on a table for ready reference.

The charts of New York Harbor and vicinity attracted the most attention, but practically every chart on hand was referred to and consulted at some time during the show. The 1:80,000 scale charts, Nos. 1211 to 1215, inclusive, were pasted together to form a complete chart of Long Island Sound, Long Island, and New York Harbor, and attracted the most attention. Next to this was chart No. 369, also pasted together to form a complete chart of New York Harbor. There were many inquiries for the new chart of New York Harbor and that of Jamaica Bay and Shinnecock Bay to Great South Bay from people who had learned from their local papers that such charts had recently been issued, clearly demonstrating the value of this method of advertising. Many people expressed a desire for a chart covering the difficult inland waterways between areas covered by these two charts.

*Coast pilots and tide tables.*—A complete set of the volumes issued by the Survey was on display. They were freely consulted and brought forth most favorable comment. The inside route pilots, and especially the one from New York to Key West, attracted the most attention.

*Special publications.*—About 20 of the more recent publications on the wire drag, magnetics, geodesy, topography, the annual reports of the Superintendent and the Secretary of Commerce, etc., were on display. They were of special interest to many people interested in the particular subjects. Each was plainly marked with the information as to how copies could be obtained.

*Instruments.*—A sextant, three-arm protractor, Courts protractor, parallel rule, and signal lamp were the instruments exhibited. An engraved plate of Woods Hole, Mass., was also on display. There were a large number of requests for an explanation of the operation of the sextant and many inquiries from amateur navigators for an explanation of the use of the parallel rule and the methods of laying off a course. The signal lamp also attracted considerable attention. It was operated by a single, 9-volt, "Hy-Watt" dry battery, made by the Cleveland Battery & Electric Co., 30 Church St., New York, and loaned for the show.

*Photographs.*—About 40 photographs illustrating different phases of Coast Survey activity were displayed. They attracted much attention from people of all classes. The wire-drag pictures were displayed by themselves in a conspicuous position and attracted a large amount of attention.

*Miscellaneous material.*—A card showing the flags of the Department of Commerce, chart showing graphically the limits of coast pilots and inside route pilots on the Atlantic coast, diagrams showing the location of wrecks in Alaska and on the Pacific coast and the relative size of Alaska as compared with New England and the United States, and some other miscellaneous material were exhibited.

The Lake Survey Bulletin and the Annual Report of the Chief of Engineers were on hand to answer specific inquiries concerning the inland waterways.

*Publications for distribution.*—The following publications were on hand for distribution: List of Publications of the Department of Commerce; Elements of Chart Making; The Work of the Coast and Geodetic Survey; The Department of Commerce; Notes Relating to the Use of Charts; Circular No. 236, The Regulation of Motor Boats; Pilot Rules; Laws and Regulations Prescribed by the Steamboat-Inspection Service; Coast and Geodetic Survey Chart Catalogue; printed cards showing the location of the suboffice and the other agencies in New York; a mimeographed list of agencies on the Atlantic coast; and a mimeographed sheet showing in tabular form the distances and maximum drafts that can be carried through the inland waterways from New York to Key West, thence to New Orleans, thence to Chicago, thence to New York by way of the Great Lakes.

The attendance at the show was said to be over 100,000, and a large percentage of this number showed more or less interest in the Coast and Geodetic Survey exhibit. After the first day, the show was open from 10.00 a. m. to 10.30 p. m., and the officer in charge was present at all times, except for two half-hour periods daily, at which times the clerk from the New York suboffice relieved him. The inspector in the New York suboffice rendered every assistance possible, both in the arrangement of the exhibit and in his attendance during some of the busiest periods. The crowds attending the show were so large that the exhibit could not be greatly expanded without requiring the attention of more than one man.

At the end of the motor boat show the exhibit was transferred to another location in the Grand Central Palace and continued throughout the Pan American Aeronautic Exposition, from February 8 to 15, inclusive.

#### DISTRICT OF COLUMBIA.

EXHIBIT OF THE COAST AND GEODETIC SURVEY AT THE ANNUAL MEETING OF THE CHAMBER OF COMMERCE OF THE UNITED STATES.

[R. P. STROUGH.]

In connection with the annual meeting of the Chamber of Commerce of the United States an exhibit was made of a selection of charts showing the progress and needs of the Survey and of some of the instruments used in the actual field work.

Due to the lack of funds and limited time available for the preparation of this exhibit, it was not possible to adequately show many of the most interesting features of the work.

Notwithstanding these drawbacks, many persons manifested an interest in the work accomplished and in the methods used in surveying operations.

#### VIRGINIA.

[F. B. T. SIEMS.]

In July, 1916, arrangements were made for taking a series of motion pictures and photographs of survey operations.

The photographic party left Washington for Norfolk, Va., on July 24.



Some delay was occasioned by the fact that films for the motion pictures were not received until July 31, but in the meanwhile, photographs were obtained and borrowed film was used in getting motion pictures of the topographic party at Lynnhaven Bay, Va.

In all, 44 motion pictures and 48 photographs were obtained illustrating various phases of the surveying operations.

The work was completed by August 7.

#### WASHINGTON.

#### VERIFICATION OF SUBMARINE SPEED TRIAL COURSE, PORT TOWNSEND BAY, WASH.

[JOHN A. DANIELS.]

In the latter part of April, 1917, the work was begun of checking the submarine speed trial course located in Port Townsend Bay, Wash., between Walan Point and Crane Point.

After an examination of the ground it was decided that the most expeditious and satisfactory means of verification would be by means of a traverse. It was also decided to establish permanent marks so that the course would be readily reestablished at any future time without remeasurements in case the range marks were destroyed.

Base measurement methods were used on the traverse. Two measurements were made of each section, and the greatest discrepancy between the two measurements of a section was 3.9 millimeters in a 1,400-meter section. The accepted value for each section was taken as the mean of the two measurements. The correction for grade was obtained by running a check line of spirit levels over the stakes. The angles at the turns in the traverse were measured with a 4-inch Berger instrument.

In order to set permanent marks at the half and quarter points, it was necessary to devise a method of locating these points accurately for this purpose. It was first determined by inspection what number of stake of the traverse fell nearest these desired points, then the horizontal distance to this stake was carefully computed. The remaining distance required to make up the half or quarter mile was then reduced to the traverse and taped off carefully from the chosen stake. The desired point on the traverse having been found, the instrument was placed over it, and a line parallel to the initial line was laid off. Upon this line at a convenient point above high water the mark was set.

The north range marks were recovered as they were originally established. This line was permanently marked as an initial line, and all other lines were referred to it. The range at the half mile and at the mile had been recently rebuilt, but the half-mile front range had been destroyed. In consequence, the ranges at the beginning and end of the mile were the only ones that could be verified.

Permanent marks for restoring the ranges at the beginning and at the end, as well as at the half and quarter mile points, were established. Explicit directions are given upon the drawing, showing the present condition of the course, for reestablishing the course at any time, no matter if all of the range marks are destroyed. The length of the course between the present ranges was found to be exactly a nautical mile.

## NEW ELECTRIC LAMPS.

On July 18 the chief of the instrument section visited the Hawthorne Manufacturing Co., at Bridgeport, Conn., to arrange in regard to the manufacture of searchlights for the new electric signal lamps. After some discussion and explanation, satisfactory arrangements were made with this firm for furnishing these lamps.

On July 19 the same officer called on H. W. McCandless Co., in New York, and learned that 100 of the special lamp bulbs made for this Survey had been forwarded the day before. These proved to be equal to the sample on which the contract had been given and were accepted.

## MISSISSIPPI RIVER COMMISSION.

[H. P. RITTER.]

In accordance with law and in addition to his other duties an officer of the Survey has continued to serve as a member of the Mississippi River Commission and to perform the duties incident thereto, including attendance at the meetings of the commission and the annual low-water inspection of the river from Rock Island, Ill., to New Orleans, La.

Respectfully,

E. LESTER JONES,  
*Superintendent.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*



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**REPORT**  
**OF THE**  
**SUPERVISING INSPECTOR GENERAL, STEAMBOAT**  
**INSPECTION SERVICE**

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# REPORT

## OF THE

# SUPERVISING INSPECTOR GENERAL

## STEAMBOAT-INSPECTION SERVICE.

DEPARTMENT OF COMMERCE,  
STEAMBOAT-INSPECTION SERVICE,  
*Washington, September 6, 1917.*

SIR: Herewith is submitted the report of the operations of the Steamboat-Inspection Service for the fiscal year ended June 30, 1917, as required by section 4403, Revised Statutes, and Department regulations relating thereto.

### ORGANIZATION.

The following positions were embraced in the Steamboat-Inspection Service at the close of business June 30, 1917:

<b>At Washington, D. C.:</b>	
Supervising Inspector General.....	1
Chief clerk (who is Acting Supervising Inspector General in the absence of that officer).....	1
Clerks.....	8
Messenger.....	1
<b>In the service at large:</b>	
Supervising inspectors.....	10
Traveling inspectors.....	2
Local inspectors of hulls.....	47
Local inspectors of boilers.....	47
Assistant inspectors of hulls.....	58
Assistant inspectors of boilers.....	58
Clerks to boards of local inspectors.....	69
<b>Total.....</b>	<b>302</b>

Thirty-two permanent positions were added to the Service during the year as follows:

One clerk in the office of the Supervising Inspector General, Washington, D. C.

One traveling inspector with headquarters at San Francisco, Cal.

One assistant inspector of hulls and one assistant inspector of boilers at each of the following ports: San Francisco, Cal.; Seattle, Wash.; Albany, N. Y.; Norfolk, Va.; Baltimore, Md.; Boston, Mass.; Providence, R. I.; Detroit, Mich.; Chicago, Ill.; Grand Haven, Mich.; and New Orleans, La.

Two assistant inspectors of hulls and two assistant inspectors of boilers at Cleveland, Ohio, and Buffalo, N. Y.

## SUMMARY OF OFFICE WORK.

Following is a summary of the work of the Office of the Supervising Inspector General for the fiscal year ended June 30, 1917:

Copies of circular letters issued .....	143, 176
Copies of Steamboat-Inspection Service Bulletins issued .....	27, 200
Excursion permits reported issued .....	209
Permits to use oil as fuel on steamers .....	127
Miscellaneous accounts examined and approved .....	1, 960
Index (card system) correspondence, new numbers .....	3, 500
Estimated number of letters answered .....	45, 000
Personal-expense accounts examined and approved .....	2, 590
Daily reports of inspectors examined and approved .....	22, 300
Returns of nonexpendable property received, examined, and filed .....	62
Returns of expendable property received, examined, and filed .....	62
Requisitions for supplies, printed stationery, and blank forms received, examined, and approved .....	1, 720
Reports of casualties and violations of law recorded and filed .....	2, 040
Special reports on casualties prepared and submitted to the Secretary of Commerce .....	1, 123
Vessel inspection cards received, examined, and filed .....	25, 000
Reports of tests of materials at mills received, recorded, and filed .....	879
Reports examined of life preservers inspected at factory .....	490
License cards received, examined, and filed .....	32, 000
Reports of absences received, examined, and filed .....	624
Reports of circular letters acknowledged, received, examined, and filed .....	732
Reports of passengers carried, received, examined, and filed .....	1, 575
Records of fusible plugs inserted in boilers received, examined, and filed .....	9, 450
Invoices of supplies, blank forms, and printed stationery received, checked, and forwarded .....	4, 500
Card records of certificates of service issued to able seamen received, examined, and filed .....	14, 000
Card records of certificates of efficiency issued to lifeboat men received, examined, and filed .....	14, 500

## EXPENDITURES.

Following is a detailed account of the expenditures for the fiscal year ended June 30, 1917:

Salaries, Supervising Inspector General, supervising and local inspectors, assistant inspectors, traveling inspectors, and clerks to local boards ..	\$491, 266. 85
Salaries, clerks and messenger in the Office of the Supervising Inspector General at Washington, D. C. ....	12, 425. 00
<b>Total</b> .....	<b>503, 691. 85</b>
Traveling expenses (actual) .....	78, 419. 96
Rents, offices .....	13, 330. 16
Furniture, instruments, etc., and repairs to same .....	11, 865. 53
Stationery, supplies, and transportation of same .....	5, 891. 27
Telephone rents and telegrams .....	3, 918. 15
Witnesses' fees and mileage in cases of investigation .....	1, 518. 43
Ice, fuel, and electric light .....	352. 65
Janitor service .....	203. 20
Moving offices .....	187. 00
Toilet service, laundry, soap, etc. ....	165. 99
Marine publications and official railway guides .....	162. 37
Miscellaneous .....	53. 00
<b>Total traveling and miscellaneous expenses</b> .....	<b>116, 067. 71</b>
<b>Salaries as noted above</b> .....	<b>503, 691. 85</b>
<b>Total expenditures for year ended June 30, 1917</b> .....	<b>619, 759. 56</b>
<b>Total expenditures for year ended June 30, 1916</b> .....	<b>555, 593. 64</b>
<b>Increase, 1917</b> .....	<b>64, 165. 92</b>

Salaries, 1917.....	\$503, 691. 85
Salaries, 1916.....	455, 683. 41
Increase, 1917.....	48, 008. 44
Contingent expenses, 1917.....	116, 067. 71
Contingent expenses, 1916.....	99, 910. 23
Increase, 1917.....	16, 157. 48
Rents, 1917.....	13, 330. 16
Rents, 1916.....	10, 722. 33
Increase, 1917.....	2, 607. 83
Traveling expenses, 1917.....	78, 419. 96
Traveling expenses, 1916.....	69, 612. 18
Increase, 1917.....	8, 807. 78

As shown above, there were increases in salaries, traveling expenses, and rents over the previous year. The increase in salaries was due to the appointment of additional inspectors and clerks, and the increase in traveling expenses was due to the fact that the number of inspectors in the Service was substantially increased during the year. During the year several offices were moved from Government buildings to private buildings, thereby increasing the amount paid for office rents.

#### NUMBER, CLASS, AND TONNAGE OF VESSELS INSPECTED.

There is submitted herewith a tabulated statement showing the number, class, and tonnage of vessels regularly inspected by this Service and granted certificates.



CERTIFICATES OF INSPECTION ISSUED TO STEAM AND MOTOR VESSELS AND TO BARGES DURING THE FISCAL YEAR ENDED JUNE 30, 1917, BY DISTRICTS.

Supervising district.	Local district.	Domestic vessels.										Foreign passenger steam vessels.				Total.	
		Steam vessels.		Motor vessels.		Passenger barges.		Seagoing barges.		Total.		Num. ber.	Gross tonnage.	Num. ber.	Gross tonnage.	Num. ber.	Gross tonnage.
		Num. ber.	Gross tonnage.	Num. ber.	Gross tonnage.	Num. ber.	Gross tonnage.	Num. ber.	Gross tonnage.	Num. ber.	Gross tonnage.						
First.....	San Francisco, Cal.	327	494,580	60	11,439	1	300	10	18,153	407	514,271	11	67,025	418	581,296	35	70,480
	Honolulu, Hawaii.	10	550	7	558			1	1,536	29	11,960	6	58,511	35	70,480	51	6,557
	Juneau, Alaska.	33	2,472	12	552			3	1,988	26	6,657			26	6,657		
	Los Angeles, Cal.	2	104	12	565												
	Portland, Oreg.	110	27,723	26	9,080	1	538	3	3,689	140	40,980			140	40,980		
	St. Michael, Alaska.	7	754	3	1,105					22	7,859	6	4,740	28	12,599		
	Seattle, Wash.	263	150,815	32	7,201			16	21,287	310	179,303	32	178,173	342	337,476		
Second.....	New York, N. Y.	1,080	884,101	43	4,262	6	2,766	157	144,512	1,295	1,035,641	91	789,964	1,386	1,825,605	157	60,308
	Albany, N. Y.	154	59,724					1	1,422	121	12,015			121	12,015		
	New Haven, Conn.	79	9,672	40	1,422			2	852	121	12,015			121	12,015		
	Philadelphia, Pa.	268	226,732	32	1,316			93	77,358	393	315,496			393	315,496		
	Portland, Me.	201	136,174	49	1,191	2	620	51	44,152	327	182,137			327	182,137		
	Baltimore, Md.	265	238,905	41	2,149			31	21,749	327	262,893			327	262,893		
	Charleston, S. C.	65	15,894	11	332			4	2,400	80	16,424			80	16,424		
	Jacksonville, Fla.	43	17,801	29	1,313			8	6,780	80	35,964			80	35,964		
	Savannah, Ga.	48	41,990	4	1,898			2	1,241	54	47,237			54	47,237		
	St. Louis, Mo.	98	18,995	4	1,895					115	20,887			115	20,887		
	St. Paul, Minn.	37	3,646	17	1,542	1	263			75	5,453			75	5,453		
Fourth.....	Dubuque, Iowa.	194	169,873	5	1,580			48	46,217	247	216,268	7	32,113	254	248,381		
	Boston, Mass.	43	37,916	12	304			9	8,607	64	16,919	3	1,089	67	18,008		
	New London, Conn.	48	20,161	7	262			3	8,167	58	28,576			58	28,576		
	Portland, Me.	81	26,511	3	134			23	20,150	77	47,208			77	47,208		
	Providence, R. I.	80	76,016	13	360			29	33,757	121	110,133			121	110,133		
Sixth.....	Louisville, Ky.	32	8,857	7	298					39	6,143			39	6,143		
	Memphis, Tenn.	48	8,385	5	242	1	315			54	8,912			54	8,912		
	Evansville, Ind.	51	6,318	6	187					67	8,375			67	8,375		
	Nashville, Tenn.	54	7,111	1	29	1	397			58	7,537			58	7,537		
	Pittsburgh, Pa.	72	11,046	2	115			74	11,180	74	11,180			74	11,180		
Seventh.....	Cincinnati, Ohio.	51	5,423	3	83			43	8,578	43	8,578			43	8,578		
	Point Pleasant, W. Va.	51	6,779	2	185			64	6,862	64	6,862			64	6,862		
	Detroit, Mich.	127	280,945	7	223			134	281,188	134	281,188	4	3,371	138	284,559		
Eighth.....	Chicago, Ill.	136	240,849	8	479			144	240,316	144	240,316			144	240,316		
	Duluth, Minn.	98	245,946	4	112	1	148	98	245,216	98	245,216			98	245,216		
	Grand Haven, Mich.	67	60,334	6	213			73	60,547	73	60,547			73	60,547		
	Marquette, Mich.	80	24,215	1	28			81	24,243	81	24,243	1	166	82	24,399		
	Milwaukee, W. Va.	141	275,748	11	453			152	276,199	152	276,199			152	276,199		
	Port Huron, Mich.	57	45,068					3	1,269	59	44,837	6	16,511	64	60,898		

Ninth.....	Cleveland, Ohio.....	178	534,540	2	44	1	107	1	2,320	179	533,890	14	32,116	179	533,890
	Buffalo, N. Y.....	261	616,416	1	40					264	615,867	14	2,947	278	617,813
	Burlington, Vt.....	13	2,869							14	2,869			15	2,948
	Cornwall, N. Y.....	61	20,421							61	20,421			64	22,338
	Toledo, Ohio.....	124	91,678	6	9,769					124	91,678			124	91,678
Tenth.....	New Orleans, La.....	192	91,678	35	4,762	5	4,877	1	1,976	228	93,654	9	23,814	243	117,488
	Alaahoum, Pa.....	41	12,282	22	3,390					41	12,282			41	12,282
	Galveston, Tex.....	53	53,772	12	3,390					53	53,772			53	53,772
	Mobile, Ala.....	79	13,649	16	1,968	1	574			79	13,649			79	13,649
	San Juan, P. R.....	11	8,037	1	35					11	8,037			11	8,037
	Total, 1917.....	5,530	5,378,156	665	60,961	21	10,905	560	501,268	5,530	5,378,156	208	1,290,279	5,894	7,249,589
	Total, 1916.....	5,818	5,288,186	694	39,664	23	10,200	574	500,225	7,109	5,303,275	240	1,536,580	7,549	7,374,805
	Increase (+) or decrease (-).....	-288	+89,970	-29	+30,297	-2	+705	-14	+1,063	-383	+124,085	-32	-247,251	-365	-125,216

## VESSELS INSPECTED AND OFFICERS LICENSED DURING THE FISCAL YEAR ENDED JUNE 30, 1917, BY GEOGRAPHICAL DIVISIONS.

Geographical division.	Domestic vessels.						Foreign passenger steam vessels.						Officers licensed.					
	Steam vessels.		Motor vessels.		Passenger barges.		Seagoing barges.		Total.		Total.		Steam vessels.		Motor vessels and barges.		Total.	
	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.	Num-ber.	Gross tonnage.
Pacific coast.....	788	688,809	161	29,388	2	838	34	46,564	965	765,569	55	308,449	2,438	1,074,048	2,400	46	4,879	12,287
Atlantic coast.....	2,629	1,942,281	289	14,201	8	3,396	461	412,099	2,387	2,371,967	107	881,856	7,402	4,798	87	2	2,712	2,712
Western rivers.....	489	76,438	80	4,514	3	975			569	81,927	28	54,495	1,375	1,335	3	2	4,633	4,633
Northern lakes.....	1,241	2,490,810	46	11,361	2	255	4	5,555	1,293	2,507,981	17	44,479	3,079	1,560	19	2	4,633	4,633
Gulf coast.....	386	179,818	89	10,497	6	5,451	61	37,070	542	232,836	17	44,479	1,192	1,241	19	2	4,633	4,633
Total, 1917.....	5,530	5,378,156	665	60,961	21	10,905	560	501,268	6,776	5,960,310	208	1,290,279	15,481	7,249,589	157	26,902	26,902	26,902
Total, 1916.....	5,818	5,288,186	694	39,664	23	10,200	574	500,225	7,109	5,303,275	240	1,536,580	8,943	9,270	196	18,102	18,102	18,102
Increase (+) or decrease (-).....	-288	+89,970	-29	+30,297	-2	+705	-14	+1,063	-383	+124,085	-32	-247,251	-365	-125,216	-32	+2,054	-32	+2,054

## MISCELLANEOUS INSPECTIONS

Following is a statement of steam vessels granted letters of approval of designs of boilers, engines, and other operating machinery inspected under an act of Congress approved June 9, 1910, which vessels are not inspected annually, only one inspection being made for letter of approval; hulls of United States Government vessels inspected; and boilers in or for United States Government steamers and buildings inspected during the year ended June 30, 1917:

Local inspection district (port).	Steam vessels granted letters of approval.		Government vessels inspected.	Government boilers inspected.	Local inspection district (port).	Steam vessels granted letters of approval.		Government vessels inspected.	Government boilers inspected.
	Num-ber.	Gross ton-nage.				Num-ber.	Gross ton-nage.		
San Francisco, Cal....	1	27	7	82	Cincinnati, Ohio.....	1	52	1	20
Honolulu, Hawaii.....				16	Point Pleasant, W. Va.....				63
Juneau, Alaska.....				4					11
Los Angeles, Cal.....				7	Detroit, Mich.....			4	1
Portland, Oreg.....	3	102		96	Chicago, Ill.....	1	19		7
St. Michael, Alaska.....			1	15	Duluth, Minn.....			2	8
Seattle, Wash.....	2	98	2	53	Grand Haven, Mich.....	2	64	2	7
New York, N. Y.....	2	30	6	85	Marquette, Mich.....	2	38	2	10
Albany, N. Y.....				6	Milwaukee, Wis.....	1	31	5	23
New Haven, Conn.....				6	Cleveland, Ohio.....	1	12		2
Philadelphia, Pa.....	1	29		31	Buffalo, N. Y.....	12	209		1
Norfolk, Va.....	1	77		34	Burlington, Vt.....				6
Baltimore, Md.....				61	Oswego, N. Y.....			1	5
Charleston, S. C.....	1	21	1	43	Toledo, Ohio.....	6	154	2	2
Jacksonville, Fla.....				7	New Orleans, La.....	1	3	17	153
Savannah, Ga.....				22	Apalachicola, Fla.....				15
St. Louis, Mo.....	1	19	1	161	Galveston, Tex.....				24
Dubuque, Iowa.....				130	Mobile, Ala.....	3	46		25
Boston, Mass.....				19	San Juan, P. R.....				3
New London, Conn.....				11					
Portland, Me.....	2	53		18	Total, 1917.....	51	1,328	82	1,580
Providence, R. I.....	1	71		19	Total, 1916.....	44	1,260	94	1,740
Louisville, Ky.....	2	83		70					
Evansville, Ind.....	2	21			Increase (+) or decrease (-).....	+7	+68	-12	-130
Memphis, Tenn.....	2	59	28	140					
Nashville, Tenn.....				84					
Pittsburgh, Pa.....				11					

## REINSPECTIONS.

Following is a statement of reinspections of passenger and ferry steamers made by boards of local inspectors during the year:

Local inspection district.	Passenger steamers.	Ferry steamers.	Total.	Local inspection district.	Passenger steamers.	Ferry steamers.	Total.
San Francisco, Cal.....		90	90	Cincinnati, Ohio.....	20	26	46
Honolulu, Hawaii.....	2		2	Point Pleasant, W. Va....	3	11	14
Los Angeles, Cal.....	2	6	8	Detroit, Mich.....	58	43	101
Portland, Oreg.....	54	23	77	Chicago, Ill.....	47		47
Seattle, Wash.....	24	3	27	Duluth, Minn.....	15	12	27
New York, N. Y.....	178	339	517	Grand Haven, Mich.....	109	8	117
Albany, N. Y.....	96	41	137	Marquette, Mich.....	7		7
New Haven, Conn.....	10		10	Milwaukee, Wis.....	23		23
Philadelphia, Pa.....	57	74	131	Port Huron, Mich.....	13	2	15
Norfolk, Va.....	146	33	179	Cleveland, Ohio.....	18		18
Baltimore, Md.....	177	3	180	Buffalo, N. Y.....	53	8	61
Charleston, S. C.....	7	2	9	Burlington, Vt.....	12	6	18
Jacksonville, Fla.....	3	1	4	Oswego, N. Y.....	24		24
Savannah, Ga.....	27		27	Toledo, Ohio.....	13	4	17
St. Louis, Mo.....	97	36	133	New Orleans, La.....	117	69	186
Dubuque, Iowa.....	31	10	41	Apalachicola, Fla.....	2		2
Boston, Mass.....	98	29	127	Galveston, Tex.....	5		5
Bangor, Me.....	24	3	27	Mobile, Ala.....	11		11
New London, Conn.....	37	9	46	San Juan, P. R.....	24	6	30
Portland, Me.....	39	8	47				
Providence, R. I.....	64	18	82	Total, 1917.....	1,868	959	2,827
Louisville, Ky.....	25	8	33	Total, 1916.....	1,889	852	2,741
Evansville, Ind.....	25	4	29				
Memphis, Tenn.....	31	7	38	Increase (+) or decrease (-).....	-21	+107	+86
Nashville, Tenn.....	37	7	44				
Pittsburgh, Pa.....	3	10	13				

## MARINE-BOILER PLATES TESTED.

During the year ended June 30, 1917, 3,609 marine-boiler plates were tested at the mills by assistant inspectors of this Service, under act of Congress approved January 22, 1894. Of this number 3,434 were accepted and 175 were rejected, as follows:

Inspected by assistant inspector—	Plates rejected because of—																Total.		
	Spotted at shears after inspection.	Lost in shipping house.	Tensile strength.	Elongation.	Lamination.	Light gauge.	Bad surface.	Excessive plates.	Spotted in flanging after inspection.	Heavy gauge.	Analysis.	Bending test.	No ring marks on plate.	Excessive sulphur.	Reduced area.	Wrong dimensions.	Rejected.	Accepted.	Inspected.
E. G. Allen, Coates- ville, Pa.....	8	12	13	11	17	2	8	8	1								75	1,793	1,868
J. B. Hayward, Pitts- burgh, Pa.....			30	2	6	2	26			2	2						70	922	992
S. A. Mills, Philadel- phia, Pa.....		1	8			1	3		2			1					16	442	458
J. T. Farnham, Chi- cago, Ill.....	1		1	6		2							1	1			12	146	158
R. B. Huston, Clevel- and, Ohio.....							2										2	125	127
R. H. Reynolds, Mil- waukee, Wis.....																		6	6
Total, 1917.....	4	13	52	19	23	7	39	8	3	2	2	1	1	1			175	3,434	3,609
Total, 1916.....	3	10	152	13	13	44	132						6		11	4	388	4,165	4,553
Increase (+) or decrease (—)...	+1	+3	-100	+6	+10	-37	-93	+8	+3	+2	+2	+1	-5	+1	-11	-4	-213	-731	-944

Also there were inspected at the mills a large number of steel bars for braces and stay bolts in marine boilers. Many requests from other branches and departments of the Government for tests of material at the mills were complied with and reports rendered to the proper officials.

#### NEW LIFE PRESERVERS INSPECTED.

During the fiscal year inspectors of this Service inspected new life preservers as follows:

Kind.	Passed.	Rejected.	Inspected.
Block cork.....	189,806	1,344	191,150
Tule.....	9,471	15	9,486
Compressed cork.....	807	.....	807
Balsa wood (A B C).....	940	.....	940
Manasik.....	200	.....	200
Total, 1917.....	201,224	1,359	202,583
Total, 1916.....	197,943	5,074	203,017
Increase (+) or decrease (-).....	+3,281	-3,715	-434

## OFFICERS LICENSED.

There were 26,962 officers of all grades licensed during the fiscal year ended June 30, 1917. The number licensed for each grade, by local districts, is shown in the following table:

Local district.	Masters of steam vessels.	Masters of ocean yachts.	Mates of ocean steamers.	Mates of inland steamers.	First-class pilots.	Second-class and special pilots.	Chief engineers.	Assistant engineers.	Special engineers.	Joint pilots and engineers.	Engineers of motor vessels other than steam.	Operators of motor vessels.	Masters of sail vessels of over 700 gross tons.	Mates of sail vessels of over 700 gross tons.	Masters of barges of over 100 gross tons.	Total of all grades.
San Francisco, Cal.	321	172	38	29	6	281	235	1	332	625	31	3	2,074			
Honolulu, Hawaii.	20	22				7	7	1	9	12			78			
Juneau, Alaska.	6	4	4			11	2	1	6	134			178			
Los Angeles, Cal.	32	13		4	6	44	5		40	237		1	381			
Portland, Oreg.	226	2	26	2	12	85	21		34	287	2	1	698			
St. Michael, Alaska.	6	5				4	2		1	59			77			
Seattle, Wash.	243	76	78	4	28	241	88	3	88	536	7	1	1,393			
New York, N. Y.	940	345	41	218	26	1,329	511		90	833	27	4	4,369			
Albany, N. Y.	62	14	18	27		147	9		9	39			325			
New Haven, Conn.	49	4	6	12	5	52	2		57	160	1		348			
Philadelphia, Pa.	146	1	24	13	27	277	56	1	26	642	5		1,147			
Norfolk, Va.	171	1	42	3	35	42	88	5	14	643	3	1	1,273			
Baltimore, Md.	206	49	36	35	29	228	75		34	348	2		1,042			
Charleston, S. C.	35	6	2	8	14	47	10	3	13	123	1		264			
Savannah, Ga.	29	9	4	11	9	84	29		19	96			280			
Jacksonville, Fla.	47	5	5	16	9	53	5		36	426	4		601			
St. Louis, Mo.	67	18	56			180	5	6	16	270			618			
Dubuque, Iowa.	51	8	22	8		73	17	1	13	244		1	438			
Boston, Mass.	177	101	9	33	42	250	110	1	49	414	14	1	1,201			
Bangor, Me.	26	3	8	3	12	33	3		8	217	3		316			
New London, Conn.	36	2	7	9	8	62	17	1	21	154			317			
Portland, Me.	54	21	5	11	5	59	9		9	218	16		407			
Providence, R. I.	53	7	6	12	6	86	15		10	190	2		387			
Louisville, Ky.	28	5	14	2		37	6		9	82		1	184			
Evansville, Ind.	29	4	9	7		32	4	1	9	154			249			
Memphis, Tenn.	24	3	16	6		50	1		6	162			268			
Nashville, Tenn.	29	4	28	3		52	3		2	88			209			
Pittsburgh, Pa.	66	8	8			79	7	1		67			236			
Cincinnati, Ohio.	37	12	11			65	10		1	44			180			
Point Pleasant, W. Va.	47	17	12	4		76	6		3	165			330			
Detroit, Mich.	158		56	15		248	48	1	7	84			618			
Chicago, Ill.	88		22	14		122	26	1	13	177			463			
Duluth, Minn.	27		19	7		45	10			35			144			
Grand Haven, Mich.	52		22	23		92	18		5	320			532			
Marquette, Wis.	14		4	9		23	1	1	12	98			152			
Milwaukee, Wis.	87		57	22		129	58	1	1	127			494			
Port Huron, Mich.	132		47	4		131	64	1	5	34			418			
Cleveland, Ohio.	143		33	13		191	57		4	54			495			
Buffalo, N. Y.	106		32	52		192	44	1	5	128		3	563			
Burlington, Vt.	4		5	3		11	2	3		48			76			
Oswego, N. Y.	39		23	16		51	9		4	339			481			
Toledo, Ohio.	36		15	10		73	14		3	45			196			
New Orleans, La.	273	37	55	62		213	53	1	88	236		1	1,036			
Apalachicola, Fla.	20	8	12	6		25	9	1	23	362			474			
Galveston, Tex.	38	1	15	3	18	67	7	3	29	328		1	515			
Mobile, Ala.	64	9	4	13	22	79	3	3	17	128	17		359			
San Juan, P. R.	6	3	4	7		14	4		9	21			68			
Total, 1917..	4,550	5	984	416	1,079	662	5,955	1,779	35	16	1,191	10,133	136	13	8	26,962
Total, 1916.	2,127	2	748	385	791	443	2,646	1,455	33	13	815	8,455	163	17	9	18,102
Increase (+) or decrease (-).	+2,423	+3	+236	+31	+288	+219	+3,309	+324	+2	+3	+376	+1,678	-27	-4	-1	+8,860

## EXAMINATIONS FOR COLOR BLINDNESS.

During the year ended June 30, 1917, 7,838 applicants for original and renewal of licenses were examined for visual defects, 61 of whom were found color blind or with other visual defects and rejected, and

7,777 were passed. As compared with the previous year these figures show an increase of 3,316 in the number examined and 3,309 in the number passed.

#### CERTIFICATES OF SERVICE ISSUED TO ABLE SEAMEN.

There is submitted herewith a tabulated statement showing the number of applications received for certificates of service as able seamen, the number of applicants rejected, and the number of certificates issued during the fiscal year ended June 30, 1917.

Local inspection district.	Applica- tions re- ceived.	Applica- tions re- jected.	Certifi- cates issued.	Local inspection district.	Applica- tions re- ceived.	Applica- tions re- jected.	Certifi- cates issued.
San Francisco, Cal. ....	707	67	640	Chicago, Ill. ....	436	28	408
Los Angeles, Cal. ....	84	3	74	Duluth, Minn. ....	288	44	244
Honolulu, Hawaii. ....	195	22	173	Grand Haven, Mich. ....	79	3	76
Juneau, Alaska. ....	4	.....	4	Marquette, Mich. ....	46	5	40
Portland, Oreg. ....	117	24	93	Milwaukee, Wis. ....	271	23	248
Seattle, Wash. ....	605	75	530	Port Huron, Mich. ....	110	.....	110
New York, N. Y. ....	4,423	327	4,096	Cleveland, Ohio. ....	724	211	513
New Haven, Conn. ....	10	.....	10	Buffalo, N. Y. ....	635	162	473
Philadelphia, Pa. ....	710	116	640	Oswego, N. Y. ....	38	.....	38
Norfolk, Va. ....	587	42	467	Toledo, Ohio. ....	245	7	238
Baltimore, Md. ....	629	63	566	New Orleans, La. ....	603	76	479
Charleston, S. C. ....	61	18	43	Apalachicola, Fla. ....	56	.....	56
Savannah, Ga. ....	808	33	775	Galveston, Tex. ....	187	10	177
Jacksonville, Fla. ....	160	23	137	Mobile, Ala. ....	467	12	455
Boston, Mass. ....	680	19	654	San Juan, P. R. ....	122	2	120
Bangor, Me. ....	58	5	53	Total, 1917. ....	14,966	1,507	13,304
New London, Conn. ....	26	4	21	Total, 1916. ....	28,019	2,317	24,426
Portland, Me. ....	248	9	239	Decrease. ....	13,053	810	11,121
Providence, R. I. ....	239	29	210				
Detroit, Mich. ....	308	45	204				

The discrepancy between the number of applications received and the number of applicants rejected and certificates issued is due to the fact that some of the applicants, after submitting their applications, failed to return from the required physical examination and also to the fact that many of the applications are still pending.

#### CERTIFICATES OF EFFICIENCY ISSUED TO LIFEBOAT MEN.

Herewith submitted is a statement showing the number of applications received for certificates of efficiency as lifeboat men, the number of applicants rejected, and the number of certificates issued during the fiscal year ended June 30, 1917.

By whom issued, port vessel, etc.	Applica- tions re- ceived.	Applica- tions re- jected.	Certifi- cates issued.	By whom issued, port vessel, etc.	Applica- tions re- ceived.	Applica- tions re- jected.	Certifi- cates issued.
Local inspectors of steam vessels:				Local inspectors of steam vessels—Continued.			
San Francisco, Cal. ....	40	.....	40	Philadelphia, Pa. ....	67	.....	67
Honolulu, Hawaii. ....	15	.....	15	Norfolk, Va. ....	29	.....	29
Juneau, Alaska. ....	1	.....	1	Baltimore, Md. ....	337	.....	337
Los Angeles, Cal. ....	140	.....	140	Charleston, S. C. ....	33	.....	33
Portland, Oreg. ....	6	.....	6	Savannah, Ga. ....	863	.....	863
St. Michael, Alaska. ....	8	.....	8	Jacksonville, Fla. ....	82	.....	82
Seattle, Wash. ....	101	.....	101	Boston, Mass. ....	190	.....	190
New York, N. Y. ....	.....	.....	.....	Bangor, Me. ....	48	.....	48
Albany, N. Y. ....	1	.....	1	New London, Conn. ....	128	.....	128
New Haven, Conn. ....	136	.....	136	Portland, Me. ....	.....	.....	.....

By whom issued, port vessel, etc.	Applica- tions re- ceived.	Applica- tions re- jected.	Certifi- cates issued.	By whom issued, port vessel, etc.	Applica- tions re- ceived.	Applica- tions re- jected.	Certifi- cates issued.
Local Inspectors of steam vessels—Continued.				Bureau of Lighthouses, Department of Commerce—Continued.			
Providence, R. I.....	162		162	Tenders—Continued.			
Detroit, Mich.....	449		449	Marigold.....	27	6	21
Chicago, Ill.....	41		41	Mayflower.....	15	1	14
Duluth, Minn.....	3		3	Mistletoe.....	11		11
Grand Haven, Mich.....	163		163	Orchid.....	12		12
Marquette, Mich.....	15		15	Pansy.....	7		7
Milwaukee, Wis.....	33		33	Rose.....	4		4
Port Huron, Mich.....	62		62	Sequoia.....	54		54
Cleveland, Ohio.....	130	29	101	Sumac.....	7		7
Buffalo, N. Y.....	70		70	Sunflower.....	16	7	9
Burlington, Vt.....	16		16	Woodbine.....	5		5
Oswego, N. Y.....	21		21	Zizania.....	16	2	14
Toledo, Ohio.....	40		40	United States Coast Guard, Navy Department:			
New Orleans, La.....	53		53	Cutters—			
Apalachicola, Fla.....	48		48	Acushnet.....	5	1	4
Galveston, Tex.....	73		73	Androscoquin.....	86	18	68
Mobile, Ala.....	61		61	Apache.....	43	15	28
San Juan, P. R.....	146	3	143	Arcata.....	309	35	274
U. S. Coast and Geodetic Survey, Department of Commerce:				Bear.....	17		17
Steamers—				Calumet.....	140	70	70
Bache.....	60	1	59	Comanche.....	28	5	23
Bear.....	17		17	Davey.....	90	1	89
Explorer.....	154	64	90	Golden Gate.....	15		15
Isis.....	8		8	Gresham.....	190	43	147
Suboffice, Galveston, Tex.....	80	17	63	Guard.....	28	8	20
Bureau of Fisheries, Department of Commerce:				Guthrie.....			8
Steamers—				Hartley.....	1,493	376	1,117
Fish Hawk.....	12	5	7	Hudson.....	555	333	222
Gannet.....	19		19	McCullough.....	66	21	45
Osprey.....	5		5	Mackinac.....	22		22
Roosevelt.....	98	3	95	Manhattan.....	210	151	59
Schooner Grampus.....	4		4	Manning.....	23		23
Navy Department:				Morrill.....	12	1	11
Receiving ships at—				Onondaga.....	54	18	36
Boston, Mass.....	210	17	193	Ossipee.....	80	29	51
New York, N. Y.....	2,007	394	1,613	Scout.....	28	5	23
Philadelphia, Pa.....	122		122	Seminole.....	9		9
Navy yards at—				Seneca.....	10		10
New Orleans, La.....	277		277	Tallapoosa.....	45	10	35
Norfolk, Va.....	133	26	107	Tampa.....	38	11	27
Puget Sound, Wash.....	6		6	Tuscarora.....	44	3	41
Bureau of Lighthouses, Department of Commerce:				Unalga.....	50	8	42
Tenders—				Winnisimmet.....	2		2
Amaranth.....	43	6	37	Wissahickon.....	147	92	55
Anemone.....	40	14	26	Yamacraw.....	46	17	29
Arbutus.....	4		4	Stations—			
Aspen.....	11		11	No. 221.....	9	1	8
Azalea.....	44	3	41	No. 232.....	33		33
Camelia.....	9		9	No. 235.....	699	433	266
Columbine.....	144	25	119	No. 237.....	218	68	162
Crocus.....	1		1	No. 238.....	54	13	41
Cypress.....	8		8	No. 239.....	479	166	313
Daisy.....	1		1	No. 240.....	38	22	16
Fern.....	4		4	No. 241.....	7	1	6
Gardenia.....	17	3	14	No. 262.....	38	9	29
Heather.....	22		22	No. 273.....	2		2
Hibiscus.....	78	3	75	No. 274.....	74	18	56
Holly.....	8		8	No. 278.....	216	55	161
Hyacinth.....	2		2	No. 279.....	46	10	36
Iris.....	5		5	No. 280.....	455	148	307
Jessamine.....	1		1	No. 284.....	38	7	29
John Rodgers.....	21	5	16	No. 285.....	12		12
Juniper.....	2		2	No. 287.....	1		1
Larkspur.....	6		6	No. 288.....	3		3
Laurel.....	9		9	No. 289.....	82	28	54
Lilac.....	183	30	153	No. 290.....	38	10	28
Madrone.....	6		6	No. 297.....	47	11	36
Magnolia.....	21	3	18	No. 304.....	60	15	45
Mangrove.....	2		2	Superintendent, ninth district.....	19		19
Manzanita.....	88		88	Superintendent, tenth district.....	16		16
Maple.....	8		8	Total.....	14,562	2,943	11,619



The following is a summary of certificates of efficiency as lifeboat men issued during the fiscal year ended June 30, 1917:

Issued by—	Applica- tions received.	Applica- tions reje. ted.	Certifi- cates issued.	Issued by—	Applica- tions received.	Applica- tions rejected.	Certifi- cates issued.
Local inspectors of steam vessels.....	3,811	32	3,779	Bureau of Lighthouses	982	108	884
U. S. Coast and Geo- detic Survey.....	319	82	237	U. S. Coast Guard.....	6,577	2,276	4,301
Bureau of Fisheries...	138	8	130	Navy Department.....	2,755	437	2,318
				Total.....	14,562	2,943	11,619

#### RECORD OF REPORTS OF CASUALTIES AND VIOLATIONS OF LAW.

Following is a statement showing the number of reports covering casualties and violations of law by vessels subject to inspection during the fiscal year ended June 30, 1917, by supervising inspection districts:

Description.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	Total.
Fire.....	12	23	7	2	4	8	.....	5	1	6	68
Collision.....	51	132	34	2	35	12	3	62	58	16	406
Explosion or accidental escape of steam.....	.....	5	2	.....	.....	.....	.....	.....	1	.....	9
Wrecked.....	3	2	.....	1	2	.....	1	.....	.....	.....	15
Stranding or grounding.....	32	17	9	1	31	3	.....	30	8	23	154
Foundered in storm.....	.....	10	3	.....	12	2	.....	1	3	11	42
Sinking.....	4	35	11	4	5	11	13	3	.....	11	97
Accidental drowning.....	20	20	7	7	4	15	11	10	8	16	118
Suicide.....	6	18	5	1	1	1	1	8	3	6	80
Miscellaneous.....	52	29	20	18	22	19	15	101	62	41	379
Violations of law.....	33	105	89	20	84	49	10	54	145	114	708
Total, 1917.....	213	396	187	56	200	120	54	274	289	251	2,040
Total, 1916.....	255	445	174	37	221	105	69	224	271	286	2,087
Increase (+) or decrease (-)	-42	-49	+13	+19	-21	+15	-15	+50	+18	-35	-47

## LIVES LOST ON VESSELS SUBJECT TO INSPECTION.

Following is a statement showing the loss of life on vessels subject to inspection during the fiscal year ended June 30, 1917, divided as to passengers and crew, by supervising inspection districts and by causes:

Supervising inspection district.	Fire.	Collision.	Explosions, escape of steam.	Wrecked.	Foundered in storm.	Sinking.	Accidental drowning.	Suicide.	Miscellaneous.	Total.
<b>First:</b>										
Passengers.....							3		4	10
Crew.....	2	11					17	3	9	42
<b>Second:</b>										
Passengers.....			6	1	96	108	20	13	1	14
Crew.....		4						5	3	243
<b>Third:</b>										
Passengers.....						4		4		8
Crew.....		6	3		10	1	7	1	1	29
<b>Fourth:</b>										
Passengers.....								1		1
Crew.....		2					7		1	10
<b>Fifth:</b>										
Passengers.....								1		1
Crew.....		6			4		4			14
<b>Sixth:</b>										
Passengers.....								1		1
Crew.....		3					15		2	20
<b>Seventh:</b>										
Passengers.....		1					4	1		6
Crew.....		2					7			9
<b>Eighth:</b>										
Passengers.....		18						3		21
Crew.....		1				1	10	5	7	24
<b>Ninth:</b>										
Passengers.....							2	1		3
Crew.....					47		6	2	7	62
<b>Tenth:</b>										
Passengers.....							3	3		6
Crew.....					44	1	13	3	7	68
<b>Total.....</b>	<b>2</b>	<b>54</b>	<b>9</b>	<b>1</b>	<b>201</b>	<b>115</b>	<b>118</b>	<b>50</b>	<b>42</b>	<b>592</b>
Passengers.....		19				4	12	31	5	71
Crew.....	2	35	9	1	201	111	106	19	37	521

a Fourteen cases due to intoxication.

b Decrease of 684 from previous year.

The following is a statement showing the number of lives lost during the fiscal year ended June 30, 1917, on passenger and non-passenger carrying vessels subject to inspection, from the various causes, shown by supervising inspection districts:

Cause.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	Total.
<b>Fire:</b>											
Passenger.....											
Nonpassenger.....	2										2
<b>Collision:</b>											
Passenger.....	7		1	2			2	18			30
Nonpassenger.....	4	4	5		6	3	1	1			24
<b>Explosions, escape of steam, etc.:</b>											
Passenger.....											
Nonpassenger.....			6	3							9
<b>Wrecked:</b>											
Passenger.....											
Nonpassenger.....			1								1
<b>Foundered in storm:</b>											
Passenger.....											
Nonpassenger.....			96	10		4			47	44	201
<b>Sinking:</b>											
Passenger.....				4							4
Nonpassenger.....			108	1				1		1	111

Cause.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	Total.
Accidental drowning:											
Passenger.....	4		1	3	1	8	6	2	3	6	34
Nonpassenger.....	16	20	6	4	3	7	5	8	5	10	84
Suicide:											
Passenger.....	6	15	4	1	1	1	1	3	1	4	37
Nonpassenger.....		3	1					5	2	2	13
Miscellaneous:											
Passenger.....	7	1	1			1				3	13
Nonpassenger.....	6	3		1		1		7	7	4	29
Total.....	52	257	37	11	15	21	15	45	65	74	593
Passenger.....	24	16	11	6	2	10	9	23	4	13	118
Nonpassenger.....	28	241	26	5	13	11	6	22	61	61	474

## ACCIDENTS RESULTING IN LOSS OF LIFE.

The total number of accidents resulting in loss of life during the past fiscal year was 257, an increase of 10 over the previous year. Enumerated by supervising inspection districts, accidents occurred as follows: First, 42; second, 63; third, 21; fourth, 10; fifth, 9; sixth, 18; seventh, 14; eighth, 28; ninth, 20; tenth, 32.

The following disasters resulted in an unusually large loss of life:

The freight steamer *Frederick* left New York in January, 1916, with a cargo of munitions, bound for Archangel, Russia, and in February, 1916, a bottle containing nine messages from members of the crew was washed ashore at the Orkney Islands, from which it appears that vessel sank in mid-ocean from some unknown cause. The entire crew, consisting of 33 men, is believed to have been lost.

On July 4, 1916, the seagoing barge *Harry Morse* was left anchored in lower Mobile Bay by the towing steamer *Asher J. Hudson*, the storm and increasing gale forcing the steamer to seek anchorage at Middle Ground. It appears that the barge and the schooner *Emma Lord* collided during the hurricane and both vessels foundered, resulting in the loss of eight lives.

On July 13, 1916, during the hurricane which raged off the South Carolina coast, the hawser between the towing steamer *Wellington* and the barges *South West* and *North West* parted and both barges were lost. The crew of the barge *North West* drifted ashore on wreckage and was saved, but the crew of the barge *South West*, consisting of five men, was lost.

On July 14, 1916, the freight steamer *Ramos*, loaded with coal, bound from Philadelphia, Pa., to Cartagena, Colombia, foundered in a hurricane, resulting in 11 of the crew losing their lives.

On August 16, 1916, the freight steamer *Admiral Clark* foundered during a hurricane off Cape San Antonio, Tex., with the result that 20 of the crew lost their lives.

On August 17, 1916, the steamer *Pilot Boy* left Galveston for Corpus Christi, Tex., encountering fair weather until Pass Cavallo was reached, when sea grew rough and wind increased rapidly. The master attempted to get vessel into Port Aransas, but the gale increased to a hurricane, which carried away part of the upper deck, allowing seas to rush into hold and engine room and causing vessel to break in two forward of engine-room bulkhead, resulting in the loss of six of the crew.

On October 20, 1916, the freight steamers *James B. Colgate* and *Merida* foundered during an extremely severe gale in Lake Erie, resulting in the loss of 24 of the crew of the former and the entire crew of 23 persons of the latter vessel.

On November 17, 1916, the towing steamers *T. A. Scott Jr.* and *Cassie* left New London, Conn., at 1.15 a. m., acting as convoy to the German merchant submarine *Deutschland* to sea, and while proceeding from New London Ledge Light to the race the *T. A. Scott Jr.*, on a course parallel to that of the submarine and the *Cassie* astern, when at a point about one-half mile west of Race Rock Light suddenly and without warning to the *Deutschland* sheered directly across the course of the latter vessel. The *Deutschland* collided with the *T. A. Scott Jr.* abaft of amidships on her port side, and as result of accident the towing steamer sank immediately and her entire crew of five men lost their lives.

On November 20, 1916, while the steamer *Rambler* was lying at Commercial Wharf, Brooklyn, N. Y., the boiler exploded from some unknown cause, killing the crew of four men.

The freight steamer *Maryland*, which was constructed for service on the Great Lakes and afterward sent to the Atlantic seaboard for ocean freight service, is supposed to have foundered about 300 miles off New York during an extremely severe storm during the latter part of December, 1916. The steamers which responded to wireless calls for assistance from this vessel were unable to find any trace of her. The entire crew of 26 persons was lost.

On December 20, 1916, a rupture of a steam pipe occurred on the steamer *Princess Anne*, due to electrolytic action, resulting in the death of three firemen.

On December 23, 1916, the freight steamer *Orleanian* left New York, N. Y., bound for Malta. An extremely severe storm occurred on December 26, during which it is supposed that vessel foundered with her entire crew of 36 men.

On January 18, 1917, while the steamer *China* was proceeding through the Shimonoseki Straits in the Inland Sea of Japan, in charge of a Japanese pilot, she collided with a towboat engaged in towing five barges. The towboat sank immediately and the entire crew of six men was lost.

On February 5, 1917, the towing steamer *Covington* with the barges *Kennebec* and *Iowa* in tow encountered a northwest gale when off Highland, en route from Hampton Roads to Providence, R. I., causing the barge *Iowa* to sink without warning, resulting in loss of crew of five men.

On March 16, 1917, the towing steamer *Bertha* in tow of the steamer *Chief* encountered a strong southeast gale about 10 p. m. when about 10 miles off Aransas Pass Light, with result that the *Bertha* broke loose from the steamer *Chief* and is supposed to have foundered with her entire crew of nine men.

On March 16, 1917, the steamer *Vigilancia*, bound from New York to Archangel, was torpedoed by a submarine, without warning, in latitude 48° 57' N., longitude 9° 34' W. The vessel was proceeding at a speed of 14 knots an hour and was struck by the torpedo about amidships. In lowering the lifeboats, 15 of the crew were swept overboard and drowned in the rough sea.

On March 21, 1917, about 8.15 p. m., the steamer *Healdton* was torpedoed, without warning, by a submarine in the North Sea, torpedo striking vessel on port side abreast of the side bunkers and fire-room, listing vessel to port and setting her on fire. Several of the crew were unable to get away from vessel, and lifeboat No. 1 capsized in the choppy sea while being launched. Nineteen of the crew of this vessel lost their lives.

On April 1, 1917, about 9.30 p. m., while the steamer *Aztec*, bound from New York to Havre, France, was approaching Oushant Island on the French coast there was, without warning, a large flash and a terrific explosion just forward of bridge on the port side, evidently caused by a torpedo from submarine. Twenty-nine of the crew lost their lives.

On April 26, 1917, the steamer *Vacuum*, without cargo, left Liverpool, England, proceeding on a course north of Ireland, which course had been prescribed by British Admiralty officers. Between 9.30 and 10 a. m., April 28, vessel was struck by a torpedo from a submarine, as result of which vessel sank and 22 of crew were lost.

On May 1, 1917, about 2.40 p. m., the steamer *Rockingham* was torpedoed by a submarine, without warning, in latitude 55° 10' N., longitude 12° 30' W., killing two of the crew and causing vessel to sink in 20 minutes.

On May 16, 1917, about 7.20 a. m., when about 3 miles off Albenga, Italy, the steamer *Hilonian* was struck by a torpedo on the port side about 30 feet forward of wheel, causing vessel to sink in about three minutes, four of the crew being lost.

On June 12, 1917, at 7 a. m., the steamer *Moreni* was sunk by a submarine about 17 miles south of Tabasca Island on the southern coast of Spain, after a battle lasting about two hours.

On June 15, 1917, the motor boat *Marion*, carrying passengers and a cargo of potatoes, sank suddenly after leaving dock at Bath, N. C., as result of overloading of vessel, resulting in four passengers losing their lives.

On June 21, 1917, about 9.30 p. m., three longshoremen entered the hold of the steamer *Comus* at New Orleans, La., and were overcome by gas, generated in hold from some cause, causing their death.

On June 30, 1917, the steamer *Christopher Columbus* was coming down the Milwaukee River stern first, with a tug at each end. At the junction of the Milwaukee and Menominee Rivers the steamer was winded in order to take her out into lake head first. As the vessel was winding, her bow struck a steel structure about 100 feet high on the wharf, causing a large water tank used for sprinkling system in an adjacent building to topple onto deck of vessel, crushing pilot house and upper decks and killing 15 passengers. Accident was caused by high water and extremely strong current in both rivers at the time.

#### PASSENGERS CARRIED.

During the fiscal year 317,095,171 passengers were carried on steam vessels that are required by law to report the number of passengers carried. Dividing this number by 71, the total number of passengers lost, shows that 4,466,129 passengers were carried for each passenger lost. The total number of lives lost from all causes, passengers and crew, was 592.

## SUMMARY OF WORK OF THE TRAVELING INSPECTORS.

The following is a statement giving a summary of the work performed by the traveling inspectors of this Service, with headquarters at New York, N. Y., and San Francisco, Cal., for the fiscal year ended June 30, 1917:

Number of vessels inspected.....	608
Gross tonnage of vessels inspected.....	1,149,027
Number of miles traveled in making inspections.....	17,666
Number of licenses examined, copied, and reported.....	1,987
Number of examinations for freeboard and loading.....	77
Number of special investigations made.....	58

## CHARACTER AND NUMBER OF DEFICIENCIES FOUND AND REPORTED.

Alarm bell.....	12	Mechanical davits.....	34
Anchors.....	8	Motor-driven lifeboats.....	8
Auxiliary lighting systems.....	8	Oil lockers.....	1
Bulkheads.....	2	Overloading of vessels.....	22
Cables.....	9	Paint lockers.....	8
Certificates of inspection.....	20	Passenger allowance.....	2
Dangerous articles.....	3	Projectiles for Lyle gun.....	3
Davits.....	9	Protection of dangerous places.....	21
Day shapes.....	4	Rags improperly carried.....	13
Deadlights.....	13	Range lights.....	4
Electric wiring.....	1	Receptacles for boat falls.....	4
Equipment not marked.....	9	Red lights.....	4
Escape ladders to lifeboats.....	22	Releasing gear.....	9
Fire buckets.....	8	Repairs to deck houses.....	12
Fire extinguishers.....	5	Repairs to hulls.....	23
Fire hose.....	10	Repairs to superstructure.....	2
Fire hydrants.....	1	Return sounder.....	4
Foghorns.....	10	Ring buoys.....	16
Fuel-oil tanks.....	1	Rotary davits.....	1
Hand deck pumps.....	9	Signal bells.....	18
Headlights.....	7	Speaking tubes.....	1
Insufficient crew.....	1	Steam fire apparatus.....	2
Insufficient lifeboatage.....	3	Steam pipes uncovered.....	2
Lamp lockers.....	6	Steam smothering pipes.....	13
Licenses of officers.....	9	Steam whistle.....	1
Lifeboats.....	14	Telephone.....	1
Lifeboat equipment.....	17	Waste improperly carried.....	1
Life preservers.....	41	Woodwork protection.....	1
Life rafts.....	6		
Life-raft equipment.....	2		
Means of escape.....	11	Total.....	512

## IMPROVEMENTS IN ADMINISTRATIVE METHODS.

The Government exists for the people and not the people for the Government. Having the same thought in mind, a bureau or service of a department exists for the people and not the people for that bureau or service. With this one thought at all times, the Bureau endeavors, consistently with the requirements of the law and of the General Rules and Regulations prescribed by the Board of Supervising Inspectors, to obtain safe conditions for persons and property and, wherever it can be done, to facilitate business with as little inconvenience to the public as possible.

## ADAPTABILITY TO CHANGING CONDITIONS.

In such a vast country as this conditions are always changing, and, therefore, methods must change to meet them. To illustrate this spirit, reference is made to the conference which occurred on August 31, 1916, in the office of the Assistant Secretary. There were present several representatives of the leading steamship companies of the United States who desired to take up with the Department the matter of the inspection of foreign-built vessels admitted to American registry, the inspection of which became due on September 4, 1916. It was apparent in the general discussion which took place that every endeavor was being made by the Bureau to meet in a businesslike way the problems that have presented themselves in regard to shipping, and the Executive order which was obtained as a result of the action of the Department in meeting the situation that presented itself shows conclusively the spirit that has prevailed in coping with changing business conditions.

The same is true with reference to numerous other incidents of the same kind which have been presented during the past fiscal year that required not only prompt action but good constructive ability to adjust matters that affected not only the shipping interests but the entire public as well.

## CONGESTION OF WORK.

For several years there has been a marked congestion in the inspection of vessels in the spring on the Great Lakes. In order to mitigate this condition to a certain extent, fall inspections of equipment were instituted on the Great Lakes, with the result that inspectors were able in a large measure to remove the cause for congestion that occurs each spring. However, that condition which makes it necessary to inspect a large number of vessels threatened to occur again during the last spring, and it was given relief by sending inspectors from the Atlantic coast to the Great Lakes. While this is an expensive procedure, and one not calculated to obtain the best administrative results, it was the only thing that the Bureau could do to meet the difficult situation, but it is to be hoped that the number of inspectors stationed on the Great Lakes will hereafter be able to take care of this work without detailing inspectors from other parts of the country to that vicinity. It is desirable that the inspectors on the Great Lakes should take care of this work themselves, because when men are taken from the Atlantic coast it results in congested conditions in the ports from which they have been taken, and efficient though they may be, they are not, of course, as familiar with Lake conditions and Lake vessels as are men who have received their training on the Great Lakes.

The volume of work which made it necessary to send inspectors from the Atlantic coast to the Great Lakes also resulted in conditions in the offices, notably at Cleveland, Ohio, and Buffalo, N. Y., which made it necessary to detail clerks to those boards to help out in the work. It is, of course, of no avail if the vessels are inspected and the inspectors are without the proper clerical assistance to issue the required certificates of inspection, licenses to men, etc., and therefore to meet this condition the Bureau not only sent clerks from other boards of local inspectors but also detailed a man from the

central office for that purpose. The work of the ninth district has been notably tied up as the result of insufficiency of force, and this has been caused by the fact that a large number of vessels lay up in that district in the fall and are, necessarily, required to be inspected in the spring. At Cleveland, Ohio, aside from the large number of vessels that are required to be inspected, it is also necessary that much testimony be taken for other boards of inspectors in connection with investigations and trials of licensed officers, and this is one great reason why the work in the Cleveland office has been behind, but as the result of special efforts which have been made in that office, as well as by the Bureau, the work is now in better condition than it has been for some time, and it is hoped that with a proper increase of force in both inspectors and clerks in the ninth district the conditions that have heretofore existed may entirely cease.

#### SUPERVISION OF THE CENTRAL OFFICE.

The Bureau has had in mind for some time the desirability of requiring local inspectors to furnish copies of all testimony adduced at investigations and trials, copies of certificates of inspection and of licenses, copies of blue prints of hulls, and copies of blue prints of boilers. While, on the one hand, it may be said that all of this information is available in the offices of the respective boards of local inspectors, it is, nevertheless, a fact that many persons having business with the Steamboat-Inspection Service very naturally feel that they should be able to obtain such data in the office of the Supervising Inspector General at Washington. It would be in the interests of good administration to have these data available at all times, but it has not been possible to do so because there has not been sufficient clerical force provided, either in the central office or in the offices throughout the field service. It is, of course, manifestly impossible at this time to undertake this work, for even were there a larger personnel in all the offices of the Service, under the war conditions that exist at present it would not be practicable to do the work outlined above. This work, however, is something that will continue to have the best thought of the Bureau, and as soon as conditions permit the Bureau purposes to formulate such regulations as will make it necessary to furnish the central office with more data regarding the activities of the inspectors in the field. At present the Bureau has excellent card-index systems showing the work done, but what is proposed is not only to have index systems as good as those now in use but also copies of the original records, so that they may be available in Washington.

The idea of the Bureau is to eliminate unnecessary processes as much as possible, and, while card reports are at present sent to the Office of the Supervising Inspector General, if the Bureau concludes to obtain copies from the local inspectors of papers of certain kinds, the card-index system which has heretofore existed will, of course, be eliminated to that extent. This would not result in a material increase in the work in the local offices, as extra copies could be taken of such documents as are required for the central office.

The Bureau maintains a vigorous follow-up system on all correspondence and reports, and it has found from experience that this pays. An order that is given and not followed up may as well not



have been given. While it is true that in nearly every instance orders that have been given were promptly obeyed, there have been, nevertheless, instances where there was too great a delay or where matters were overlooked; hence, the necessity for a follow-up system.

The same principle has been followed out with reference to the work of the traveling inspectors of the Service. As complaints are received and referred to boards of local inspectors, they not only have to be approved by the supervising inspector of the district, but as the traveling inspectors have work in certain vicinities they are also required to look up the cases that are referred to in the complaints and to approve them and return them to the Bureau.

At the beginning of the present fiscal year there were nearly 17,000 card reports that had been received in the central office but which had not been examined and filed. Now, however, all of the reports that have been received have been examined and filed, and the work of the Bureau is nearly up to date, and this notwithstanding the unusual conditions that have existed during the past fiscal year. The reason that the work has been kept up is due to good organization and also to the fact that in the central office there is a most excellent corps of employees.

#### TESTS OF FIRE EXTINGUISHERS.

It will be recalled that for many years there appeared in the editions of the General Rules and Regulations a long list of fire extinguishers that had been approved by the Board of Supervising Inspectors. Experience showed, however, that this list needed revising, and it was accordingly revised. The Bureau obtained samples of extinguishers from all the firms whose products had been listed by the Board of Supervising Inspectors, and these extinguishers were submitted to exhaustive tests by the Bureau of Standards, this Department. As the result of those tests, the list that appears now in the General Rules and Regulations is not as long as it was formerly, but the Bureau believes that there is no name on that list that should not be there. It was an immense undertaking to test all of the extinguishers that had been approved in past years by the Board of Supervising Inspectors, and in making these tests and in deciding what extinguishers should appear on the list the Bureau proceeded in an equitable manner toward those whose names had heretofore appeared. In the case of some extinguishers it was necessary to take them off the list at once, and these extinguishers may no longer be used after the close of the present calendar year. In the opinion of the Board of Supervising Inspectors other extinguishers could be used until December 31, 1919, but after that date their names will not appear on the approved list unless they have been tested again by the Bureau of Standards, this Department, and found to meet the requirements with reference to the best construction of fire extinguishers in all respects. After January 1, 1920, all fire extinguishers must meet the tests of the Bureau of Standards in all particulars.

#### INCREASE IN PERSONNEL.

It matters not how excellently an officer may plan his work or how rigorous the laws and General Rules and Regulations may be, good results can not be obtained, in an administrative sense, if it is neces-

sary to undertake too large an amount of work with too small a number of men. During the last fiscal year there were added one traveling inspector, whose headquarters is on the Pacific coast, 15 assistant inspectors of hulls, and 15 assistant inspectors of boilers. There was also added one clerk in the office of the Supervising Inspector General. Congress, in addition, provided for the creation of a board of local inspectors at Tampa, Fla.

The result of the appointment of the additional inspectors has been that prompter service has been given to vessels required to be inspected, and also that more attention has been given to certain details of inspection. It is very natural that there should be an increase in the personnel of the Steamboat-Inspection Service when one considers the present expansion that is taking place in the American merchant marine, and as these vessels are subject to the inspection of this Service it follows that there must be an increase in the number of inspectors and clerks. While Congress has given attention to the matter of increasing the number of inspectors, it has not provided for a sufficient number of clerks to do the work in the offices of the local inspectors in the best manner, and it is to be hoped that this feature of the work of this Service will not longer be overlooked by that body.

In connection with the increase in the personnel, it is not out of place to refer to the necessity of increasing the pay of all inspectors and clerks. While the Bureau realizes that at the present time the Federal Government is under an enormous expense incident to the prosecution of the war against the Imperial German Government, it is not to be forgotten that the pay of men in industrial enterprises outside of the Government has materially increased during the last few years. The small increase that has been given has certainly been more than justified because of the increase in the cost of living, and it is not to be forgotten that the employees of the Federal Government require the necessities of life as well as the employees of private corporations. The conditions that exist in the Steamboat-Inspection Service are peculiar. There never was a time when there was a greater demand for ships than at present, and the demand for men is even greater than for ships. The wages paid by companies operating vessels are enormous, and while it is not recommended nor asked that the inspectors of this Service be given such an increase in pay as that given by companies, it is, nevertheless, believed that an increase of 50 per cent in the pay of inspectors would not be unreasonable.

It was pointed out in the last annual report that clerks of this Service getting \$900 per annum are required to do work for which \$1,800 is paid outside of the Service, and it is no answer to say that if this is true the men in the Service may resign and obtain the larger compensation outside of the Government. It has been pointed out that men within the Service are helpless in the matter of getting greater compensation from within, and they are peculiarly handicapped in their efforts to obtain employment from without. Handicapped though they may be, it is, nevertheless, a fact that the Bureau is meeting greater difficulty every day in obtaining competent clerks, and this is proved by the number of temporary appointees in permanent positions of the field service.

## OVERLOADING OF STEAMERS.

In connection with this subject one's mind logically turns to the problem of preventing the overloading of steamers carrying passengers. The Bureau believes that in a large measure that has been overcome, and in this connection it is pointed out that sections 4464, 4465, and 4466, Revised Statutes, have been substantially amended so that there now rests upon the supervising inspectors of the respective districts the responsibility of approving the passenger allowance on vessels coming under their jurisdiction. This condition results in a check upon the action of the local inspectors who have original jurisdiction in the premises.

In addition, stability tests may now be conducted by an expert detailed for that purpose, and during the past fiscal year several such tests have been made. Now in any instance where local inspectors are in doubt, they promptly bring the matter to the attention of the Bureau and arrangements are made to have the proper stability test made.

It is also pointed out that at the last meeting of the Board of Supervising Inspectors the matter of overloading passenger steamers received the attention of that body. The matter was thoroughly gone into, and each supervising inspector now understands what is required of him with reference to preventing unreasonable increase in passenger allowances.

Passenger steamers, however, are not the only class of vessels where attention must be given to the matter of overloading. The Bureau has reference to the overloading of freight steamers. It is to be recalled that at the present time there is no law against the overloading of steamers of this class. Nevertheless, efforts were made during the fall of 1916 to prevent this practice, by detailing at certain special ports on the Great Lakes inspectors whose business it was to watch this particular danger, and very excellent results were obtained. The conditions that exist, however, leave much to be desired, and the one way to do this thing properly is to have a law enacted that will give the Steamboat-Inspection Service the authority of saying how deeply a vessel may be loaded. This will result in not only fairer conditions to the owners of vessels but also to the inspectors, because inspectors under present conditions are entirely without authority and can exercise at the most only strong moral suasion. It may be stated, however, that so far as overloading on the Great Lakes is concerned the owners cooperated with the Department, and much of the success that was obtained during the fall of 1916 was due not to the existence of any law, because none exists, but to this cooperation on the part of the owners.

## WAR MEASURES.

It has been said that war conditions give rise to a demand for men not of qualitative but of quantitative minds. In other words, at such a time as this it is necessary not so much to argue how things may not be done as to find ways in which things may be done. This Bureau takes pleasure in pointing out that when the United States Government declared war against the Imperial German Government

the Steamboat-Inspection Service was called upon to do things which taxed it to the utmost, and in the doing of these things the Bureau at no time failed. As unusual demands were made on inspectors, those demands were met by the inspectors, and this without any increase in their number. To any thinking person it must be evident that the Steamboat-Inspection Service could not have met the demands on it had not the small force worked overtime and given the best that was in them every day, including Sundays and holidays.

Inspectors of this Service were detailed to the Cape Cod Canal to watch vessels navigating that body of water, and they accompanied vessels through the canal, and there was no untoward incident on that important body of water that stopped the traffic.

The Bureau was called upon by the United States Shipping Board to examine the interned German vessels after seizure by the Government, and when one remembers the vast damage that was found to have been done those vessels it is then easy to realize the magnitude of the task. This inspection was not only thoroughly done, but it was promptly undertaken by the Steamboat-Inspection Service. The answer of the Service was not that it did not have sufficient men to do the work with the other work demanded of it, but the Service did the work and submitted reports to the United States Shipping Board.

To anyone familiar with shipping conditions it could have been prophesied long before the present war that the condition in which the United States would find itself if it engaged in war with any first-class power would be serious, and that fact has been from time to time pointed out by the Bureau; but great as the demand is for material and for ships, greater still is the demand for men. With our abundant resources for manufacturing iron and steel and with our unlimited forests the material for ships can be obtained, and with our splendid organization in the manufacture of iron and steel the finished product can be obtained in the way of plates for hulls and boilers; but men can not be obtained overnight or within a week or two, and this is a great constructive problem which confronts the American people at this time. The inspectors of this Service have been busily engaged in cooperating with the recruiting service of the United States Shipping Board in furnishing information with reference to the officers who are available to man the ships when they are ready, and they have also been approving the applications of persons who desire to enter the nautical schools that are being conducted by the recruiting service of this board. While this has entailed an enormous amount of work in the offices of the local inspectors, both so far as inspectors and clerks are concerned, the Service has not refused to undertake the work, nor even suggested that it was impossible to do so. Its answer has been in this case as in the case of interned vessels, that it has done the work. Reference is made to the matter in order that the fact may be pressed home that there must be more men furnished the Steamboat-Inspection Service or its regular and special work can not be kept up.

In connection with the mobilization of the resources of the United States in the present great conflict with the Imperial German Government, it is to be remembered that the great fleet of boats navigating the northwestern waters of this country and the lower lakes

has been kept in motion, and the Steamboat-Inspection Service has had no small part in the work. It caused the congested conditions existing on the Great Lakes with reference to the inspection of vessels to be relieved, and this was done promptly, though at great expense to the Service.

War conditions beget war measures to meet them, and there has been no more important work done by the executive committees of the Board of Supervising Inspectors than formulating the new regulations that have been adopted with reference to obtaining licenses. Everything has been done that can be done to make it possible for competent applicants to obtain licenses, and, therefore, all over the country at the present moment, not only by the liberal features that have been embodied in the General Rules and Regulations prescribed by the Board of Supervising Inspectors but also by the discretion that has in important instances been vested in local inspectors, men are able as never before to obtain licenses to serve in the American merchant marine.

#### REMEDIAL LEGISLATION.

There have been introduced in Congress important bills relating to the work of this Service. Only one or two have been enacted into law. There are other important measures yet to receive the attention of Congress which relate to this Service, and reference is simply made to them here in order that it may be known that this office has not overlooked them. It is realized, however, that at such a time as this Congress is necessarily occupied with war measures, and the legislation referred to may very properly wait until the present war shall have terminated.

#### APPENDIX.

There is attached hereto an appendix containing general statistics of the Service compiled from the reports of the supervising inspectors of the various districts for the year ended June 30, 1917, indicating the nature and extent of the work of the Service.\*

Respectfully,

GEO. UHLER,  
*Supervising Inspector General.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*

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\* Appendix is published in the pamphlet edition of the report of the Supervising Inspector General, but omitted from this volume.

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**REPORT**  
**OF THE**  
**COMMISSIONER OF NAVIGATION**

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# REPORT

OF THE

## COMMISSIONER OF NAVIGATION.\*

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DEPARTMENT OF COMMERCE,  
BUREAU OF NAVIGATION,  
*Washington, September 25, 1917.*

SIR: There is submitted herewith my annual report for the fiscal year ended June 30, 1917.

In compliance with your instructions, the detailed tables and summaries showing the rapid growth of the shipbuilding industry and of the merchant marine which have been reported to you as usual will be withheld from publication for the present. It will suffice to say that during the past fiscal year the tonnage built was by far the greatest in our history and that the plans and prospects at the date this report is completed promise to result during the 12 months following it in an output of merchant ships by our shipyards equal to or greater than the world's total output during any year before the war.

### WORK OF SHIPPING COMMISSIONERS.

Summaries of the routine work of shipping commissioners for the past fiscal year are printed in Appendix A. The amount of this work has steadily increased since the outbreak of the war, but the routine statistics are far from indicating the amount of the increased work due to war conditions. The prompt dispatch of ships is more important than ever. The concern of relatives over the whereabouts of seamen who have joined ships passing through the German death zone has increased the amount of correspondence about individual seamen, and since the declaration of war on April 6 shipping commissioners have undertaken to keep spies, usually in neutral guise, from shipping as seamen on American ships. Passports or certificates of American citizenship are required of American seamen, and foreign seamen are now required to furnish certificates of nationality wherever practical. In this work the inspectors of the Immigration Service and the shipping commissioners are acting in concert or supplementing each other's work.

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\* Appendixes and statistical tables referred to in the text following are printed in the pamphlet edition of the Commissioner's report, but omitted from this volume.



**MEN SHIPPED AND DISCHARGED.**

During the past fiscal year 506,941 officers and men have been shipped and discharged by shipping commissioners, compared with 487,524 during the fiscal year 1916, 414,744 during the fiscal year 1915, and 378,772 during the fiscal year 1914. Shipping commissioners were provided for by Congress at 13 of our principal seaports, and at other ports collectors of customs shipped and discharged 18,439 officers and men. Of these, 3,453 were shipped and discharged at Newport News, Va. At least during the war a shipping commissioner's office should be established at that point, and the estimates this year again recommend the small sum needed for the purpose. The ports of the Chesapeake Bay are especially important in the prosecution of the war.

The following table shows the aggregate routine work and salaries of shipping commissioners and deputies for the past decade:

Year.	Seamen shipped, reshipped, and discharged.	Salaries.	Average cost per man.	Year.	Seamen shipped, reshipped, and discharged.	Salaries.	Average cost per man.
1908.....	307,309	\$63,585.16	\$0.21	1913.....	379,188	\$62,374.13	\$0.16
1909.....	341,980	63,944.79	.18	1914.....	378,772	63,475.20	.17
1910.....	356,448	65,539.19	.18	1915.....	414,744	63,755.47	.15
1911.....	367,023	67,155.90	.18	1916.....	487,524	62,637.45	.13
1912.....	374,783	68,373.53	.17	1917.....	506,941	66,211.83	.13

**DESERTION OF SEAMEN.**

Under the abnormal conditions brought about by the war the reports of American consuls of seamen deserting from American ships in the ports of Europe, Asia, Africa, South America, Australia, and the foreign islands of the Pacific have little permanent value, and for this reason such reports as have been received have not been tabulated. The principal seaports of all belligerent nations are under military control, and seamen are allowed to land only upon compliance with strict military regulations.

The following statement shows the number of men who have failed to join American ships in American ports after signing contracts before shipping commissioners:

Year.	Shipped and re-shipped.	Failed to join.	Per cent.	Year.	Shipped and re-shipped.	Failed to join.	Per cent.
1908.....	163,192	3,101	1.90	1913.....	198,024	2,906	1.97
1909.....	181,032	2,114	1.17	1914.....	190,584	2,771	1.39
1910.....	185,721	2,690	1.45	1915.....	218,541	2,339	1.03
1911.....	192,191	3,082	1.60	1916.....	252,681	4,512	1.71
1912.....	198,225	3,849	1.94	1917.....	267,327	5,006	1.86

The seamen's act abrogated treaties providing for the arrest of seamen for desertion from foreign merchant ships in ports of the United States on and after July 1, 1916, and this provision of the act, as well as the provisions affecting the payment of part wages

of such deserting seamen, has, accordingly, been in effect throughout the fiscal year. Under war conditions, as was stated last year, the crews of belligerent merchant ships naturally stand by their colors as well as by their contracts, but in some instances, particularly in Gulf ports, complaint has been made that crews of foreign ships have been induced to desert, with resulting delays to commerce and embarrassment to the vigorous prosecution of the war.

#### ALLOTMENT NOTES.

The following table shows the number of allotment notes issued in recent years under section 24 of the seamen's act of December 21, 1898, and since November 4, 1915, under the seamen's act, to seamen on vessels of the United States:

Year.	Creditors.		Rela- tives.	Total.	Year.	Creditors.		Rela- tives.	Total.
	Square- rigged.	All other vessels.				Square- rigged.	All other vessels.		
1904.....	1,966	1,513	287	3,766	1911.....	505	241	57	803
1905.....	1,596	919	304	2,818	1912.....	555	296	62	913
1906.....	1,492	421	300	2,222	1913.....	419	135	64	668
1907.....	1,323	490	289	2,062	1914.....	257	279	166	702
1908.....	967	393	133	1,493	1915.....	400	595	682	1,677
1909.....	660	114	84	858	1916.....	100	303	1,174	1,577
1910.....	631	145	79	905	1917.....			1,650	1,650

#### WAGES OF SEAMEN.

The customary tables showing the rates of monthly wages paid on merchant vessels of the United States during the past fiscal year for various ratings at various principal ports of the United States, as reported by shipping commissioners from articles of agreement signed before them, are published in Appendix B. In addition to the monthly wages, war bonuses are paid, as a rule, to seamen on ships bound through zones in which Germans deal death indiscriminately. These bonuses are usually 50 per cent of the wages. Furthermore, for over a year American shipowners in many instances have insured the lives and effects of their crews on ships passing through these zones, and such insurance is obligatory upon all shipowners under the extension of the war risk insurance act now in force.

#### NATIONALITY OF CREWS.

The table following shows the nationality of officers and crews of American merchant vessels shipped before United States shipping commissioners during the past fiscal year compared with recent years. War with Germany was not declared until April 6, 1917, and during most of the fiscal year, accordingly, Germans were at liberty to seek employment on American merchant ships. On June 12, 1917,

instructions were issued prohibiting the employment of alien enemies on American merchant ships, except in individual cases with the specific approval of the Department of Justice.

Nationality.	1910	1911	1912	1913	1914	1915	1916	1917
Americans (born).....	59,810	59,902	58,109	63,040	63,247	65,196	76,966	81,889
Americans (naturalized).....	31,736	31,810	35,562	32,790	31,417	29,965	31,877	26,526
British.....	21,047	23,674	21,023	24,031	24,745	29,395	29,523	28,947
Chinese.....	137	68	55	65	64	471	68	42
Japanese.....	480	380	280	193	98	200	245	305
Filipinos.....	126	126	184	258	472	482	528	650
Germans.....	6,832	7,673	7,185	9,185	9,497	9,496	12,415	10,254
Norwegians.....	9,190	9,889	9,394	8,679	8,194	9,891	11,353	9,819
Swedes.....	7,123	6,615	7,866	6,996	6,321	7,878	9,208	9,506
Danes.....	2,293	2,590	2,744	2,510	2,260	4,084	4,608	4,993
Russians.....	3,694	3,856	4,403	4,453	4,526	5,930	7,949	8,150
Austrians.....	1,513	1,838	2,240	2,980	3,363	3,536	3,474	1,894
French.....	517	610	614	615	617	716	892	788
Spanish.....	24,546	26,059	26,247	20,511	25,022	25,252	33,139	34,006
Italians.....	3,649	4,021	3,877	4,813	4,368	4,843	4,150	4,079
Portuguese.....	4,073	4,197	3,924	4,384	3,921	5,034	4,733	5,702
Others.....	8,962	8,786	11,763	12,434	11,442	16,196	21,533	25,322
Unknown.....	13	117	3,037	68	10	6	.....	2
Total.....	185,721	192,191	198,225	198,024	199,584	218,541	252,681	253,141
Per cent Americans.....	49.3	47.7	47.3	48.4	47.4	48.5	43.2	42.9

#### NAVIGATION RECEIPTS.

The receipts for the past four fiscal years from the three main sources of revenue from navigation are shown in the following table:

Source.	1914	1915	1916	1917
Tonnage duties.....	\$1,310,759.03	\$1,315,425.30	\$1,454,565.83	\$1,393,743.16
Navigation fees.....	152,694.19	142,446.37	158,518.08	159,808.08
Navigation fines.....	40,741.38	41,518.24	52,381.75	49,962.37
Total.....	1,504,194.60	1,499,389.91	1,665,465.66	1,603,513.56

#### TONNAGE DUTIES.

The receipts from tonnage duties during the year ended June 30, 1917, were \$1,393,743.16, including \$2,901.90 collected for the Philippine Islands fund and \$6,022.10 alien and penal tonnage duties. The year's receipts were \$60,822.67 less than during the previous fiscal year, when they were the largest for any year since the Civil War period. Under the German threat in February to sink without warning neutral ships, American ships ceased sailing for a brief period until they could be armed against piracy, and ships under other neutral flags also in some instances ceased operations. The reduction in this year's tonnage receipts, amounting to the average receipts for a fortnight, was due mainly to this cause. Details of the receipts of tonnage duties are stated in Appendix D.

#### RADIO COMMUNICATION.

Submarine assaults have required radio inspectors to give special attention to the radio equipment on vessels entering the war zone. During the past fiscal year there were 12,139 clearances of radio-

equipped vessels coming under the act of June 24, 1910, amended July 23, 1912, and 6,103 inspections were made of the radio equipment on these vessels as compared with 11,111 clearances and 6,125 inspections during the fiscal year 1916. These inspections disclosed 502 cases where the equipment did not comply with the requirements of the law or where no equipment at all had been provided. Of these cases, 278 were found on foreign vessels and 143 on American vessels. A great many minor defects were noted but were remedied by the inspectors at the time of inspections.

The small decrease in the number of inspections is due to the many changes in the inspection force, as all of the original inspectors in the field service voluntarily entered the service of the Army and Navy as reserve officers, necessitating the employment of new men unfamiliar with the duties. Two of the inspectors entered the service of the Army, one receiving the rank of major and one of captain; nine entered the service of the Navy, four receiving the rank of lieutenant, three of lieutenant junior grade, and two of ensign.

During the fiscal year many vessels equipped with radio apparatus have been sunk. The value of this apparatus is illustrated in the following extract from the log of an American vessel:

*July 4, 1917.*—Chased by submarine. Got into communication with British destroyer by wireless. Fired three shots at submarine. Destroyer to our assistance. Submarine disappeared.

*July 5, 1917.*—Heard shots being fired about 8 a. m. and picked up distress from British ship saying she was being shelled. 8.30 a. m., saw sailing ship blown up about 3 miles ahead of us. 9.45, chased by submarine. Got into communication with two British destroyers and French land station. They sent an aeroplane to our assistance in response to our distress call. Submarine submerged. Fog came up. 3.30 p. m., fog lifted. Submarine 2 miles from us opened fire upon us. Got into communication with land station and several destroyers answered, saying they were coming to our assistance. Battle lasted 55 minutes. Submarine sunk by our gun fire. Fragment of shell struck our stern plates, requiring 79 rivets when we reached France.

*July 27, 1917.*—Sailed for New York.

*July 30, 1917—4.30 a. m.*—Picked up 23 survivors of the torpedoed British ship ———. Sent code message asking a destroyer to relieve us of them, as we had only a sufficient number of lifeboats for our own crew. 10 a. m., relieved of ——— survivors by British patrol.

*August 1, 1917.*—Ship took fire. Burning oil for fuel. Sent distress call. All hands to lifeboats. Rescued by Greek ship ———. Taken to ———, ———. Returned to New York on American steamship ———.

The Navy Department, acting under authority of an Executive order, dated April 6, 1917, ordered the closing of the 6,089 licensed amateur transmitting radio stations and also all amateur receiving stations and such commercial radio stations as were not required for naval communication.

At the beginning of the war a heavy demand for commercial operators was made by the War and Navy departments, and the large reserve of amateur radio operators made it possible to supply the increased demand. By consulting the lists of licensed amateur radio stations it was possible to communicate with practically every available amateur radio operator in the United States within a short time.

All of the radio inspectors are making special efforts to supply the unusual demand for commercial operators. To accomplish this they

are acting as instructors in radio schools, lecturing in radio clubs, and canvassing their districts through correspondence, which is resulting in a large number of amateurs and those who have not heretofore been interested in radiotelegraphy obtaining the necessary knowledge to pass the commercial examinations. The Bureau is directing its radio inspectors to visit all of the important cities throughout the country whenever there is a class of students prepared to take its examinations. This has resulted in securing 680 new commercial operators between April 1 and June 30, or from the time this country entered the war to the end of the fiscal year.

Mr. Marconi, referring to amateur radio operators, says:

America is fortunate in having perfected its organization of the amateur field. \* \* \* American wireless men are exceptionally well qualified to take an active part in important signaling work. Much valuable material will be found in the amateur ranks, as these young men are accustomed to transmission on short wave lengths. A great deal of our communication is carried on with low power and wave lengths in the neighborhood of 200 meters—the exact type of communication to which they are most accustomed.

The number and grade of licenses issued to operators during the past year and previous four years is shown below.

Grade.	1913	1914	1915	1916	1917	Total.
Commercial extra first.....			18	18	8	44
Commercial first and second.....	1,932	339	1,635	1,260	1,674	6,940
Experiment and instruction.....	8	10	27	30	10	85
Cargo.....	1	26	112	173	113	425
Amateur first and second.....	1,841	1,172	3,067	4,199	3,302	13,581
Commercial emergency first and second.....					217	217
Total.....	3,782	1,547	4,859	5,680	5,324	21,192

During the past fiscal year 4,417 licenses to stations were issued, compared with 5,601 for the previous year. Classification of these stations is shown in the following table:

Class.	1916	1917	Class.	1916	1917
Commercial ship.....	444	484	Technical and training school.....	33	33
General public service land.....	51	44	Special amateur.....	67	54
Limited public service land.....	17	20	General and restricted amateur.....	4,875	3,067
Limited commercial land.....	57	46	Total.....	5,001	4,417
Experimental.....	57	50			

The decrease in the number of station licenses issued is due to the discontinuance of licensing land stations, including amateur stations, at the beginning of the war. The total number of station licenses issued for the fiscal years 1913 to 1917, inclusive, is as follows: 1913, 1,496; 1914, 2,309; 1915, 4,039; 1916, 5,601; 1917, 4,417; total, 17,862.

The statement following shows details of expenditures for this service during the fiscal years 1913, 1914, 1915, 1916, and 1917; the proposed distribution for the current fiscal year; and the estimates for 1919:

	1913	1914	1915	1916	1917	1918	1919
<b>Total salaries:</b>							
Field.....	\$15,673.58	\$24,082.50	\$27,844.49	\$28,379.51	\$27,794.66	\$31,880.00	\$31,880.00
Bureau.....	4,328.22	5,793.75	7,150.00	7,150.00	7,013.34	8,060.00	8,060.00
<b>Total.....</b>	<b>20,001.80</b>	<b>29,876.25</b>	<b>34,994.49</b>	<b>35,529.51</b>	<b>34,798.00</b>	<b>39,930.00</b>	<b>39,930.00</b>
<b>General expenses:</b>							
Travel.....	4,150.93	6,044.10	6,245.82	4,355.12	2,317.42	2,000.00	2,000.00
Telephone.....	126.84	364.71	399.84	401.81	565.88	600.00	600.00
Laundry.....	22.22	127.04					
Furniture.....	208.21		370.26	441.77	151.64	150.00	150.00
Supplies.....	623.51	638.91	517.49	331.90	558.76	500.00	500.00
Printing.....	2 124.12	20.81	78.10	116.80	68.79	75.00	75.00
New instruments.....	9,972.40	171.11	312.79	2,788.75	2,741.09	1,000.00	1,000.00
Repairs.....	20.80	46.93	1,455.65	109.78	82.05	78.00	78.00
Telegrams.....	74.23	34.87	111.51	33.47	24.33	25.00	25.00
Freight and cartage.....	210.49	234.59	124.84	89.34	63.23	65.00	65.00
Car fare.....			218.08	339.15	330.16	350.00	350.00
Technical books and papers, batteries, wire, and other small materials.....			168.38	57.00	47.30	50.00	50.00
Reprints.....				198.91	13.74	15.00	15.00
Rent.....					98.75	162.00	162.00
Unexpended.....	44.45	342.68	3.10	208.89	3,137.86		
<b>Grand total.....</b>	<b>37,880.00</b>	<b>37,880.00</b>	<b>45,000.00</b>	<b>45,000.00</b>	<b>45,000.00</b>	<b>45,000.00</b>	<b>45,000.00</b>

The number of clearances of ships required to carry wireless and of the inspections of such ships is shown by the following statement:

CLEARANCES AND INSPECTIONS OF VESSELS SUBJECT TO THE SHIP ACT OF JUNE 24, 1910, AS AMENDED JULY 23, 1912, DURING THE FISCAL YEAR 1917.

[District headquarters are indicated by small capitals.]

District.	Port.	Clearances.	Inspections.	District.	Port.	Clearances.	Inspections.
1st	BOSTON, MASS.....	990	721	5th	Port Arthur, Tex.....	58	0
	Portland, Me.....	151	8	6th	SAN FRANCISCO, CAL.....	1,156	1,060
	Providence, R. I.....	124	1		Eureka, Cal.....	57	0
2d	NEW YORK, N. Y.....	3,065	2,296		Honolulu, Hawaii.....	210	0
	Perth Amboy and Newark, N. J.....	15	0		Los Angeles, Cal.....	316	0
3d	BALTIMORE, MD.....	454	430		San Diego, Cal.....	161	0
	Newport News, Va.....	381	104	7th	SEATTLE, WASH.....	487	507
	Norfolk, Va.....	1,036	360		Astoria, Oreg.....	131	0
	Philadelphia, Pa.....	232	40		Ketchikan, Alaska.....	335	0
4th	SAVANNAH, GA.....	385	4		Portland, Oreg.....	127	0
	Charleston, S. C.....	207	3		Tacoma, Wash.....	29	0
	Key West, Fla.....	289	3	8th	DETROIT, MICH.....	169	44
	Pensacola, Fla.....	7	0		Buffalo, N. Y.....	183	3
	San Juan, P. R.....	267	0	9th	CHICAGO, ILL.....	89	66
	Tampa, Fla.....	202	0		Duluth, Minn.....	62	1
5th	NEW ORLEANS, LA.....	487	448		<b>Total, 1917.....</b>	<b>12,139</b>	<b>6,108</b>
	Galveston, Tex.....	232	4		<b>Total, 1916.....</b>	<b>11,111</b>	<b>6,125</b>
	Mobile, Ala.....	35	0				

The total number of ship inspections for the fiscal years 1913 to 1917, inclusive, is as follows: 1913, 3,201; 1914, 6,486; 1915, 6,152; 1916, 7,236; 1917, 7,137; total, 30,212.

The following is a classified list of the defects found during the fiscal year in radio stations on board ship for which official notices were served on the masters by radio inspectors, requiring that the deficiencies be remedied prior to the sailing of the vessels. In each

case the radio inspector took the necessary steps to place the station in proper condition before sailing, thus preventing a violation of the law.

Defects noted.	Number.
Inefficient auxiliary apparatus, inefficient auxiliary source of power supply, or lack of same. ....	149
Inefficient main transmitter used as auxiliary transmitter. ....	28
Inefficient means of communication between the radio room and the bridge or lack of same. ....	211
Improper complement of radio operators. ....	87
Inefficient receiving set or lack of same. ....	21
Lack of radio equipment where required. ....	8
Total number of defects noted. ....	582

NATURE, AMOUNT, AND GEOGRAPHICAL DISTRIBUTION OF WORK PERFORMED DURING THE PAST FISCAL YEAR, AS COMPARED WITH THE FISCAL YEAR 1916, BY THE RADIO SERVICE, UNDER THE ACT (OF 1912) TO REGULATE RADIO COMMUNICATION.

[District headquarters are indicated by small capitals.]

Place of inspection or examination.	Stations inspected.					Operators licensed.					Operators examined.					Operators licensed.				
	Ship—Voluntary equipment.	Ship for license.	Land.	Land for license.	General and restricted amateur.	Amateur stations licensed.	Commercial.				Amateur.				Cargo.	Commercial.				Experiment and instruction.
							Extra first.	First.	Second.	First.	First.	Second.	First.	Second.		Extra first.	First.	Second.	First.	
First district:	67	22	1	1	14	610	2	155	28	280	135	23	0	1	172	25	355	209	23	0
Boston, Mass.																				
Bridgport, Conn.					13															
Brockton, Mass.					1															
Fall River, Mass.		1																		
Hartford, Conn.																				
New Britain, Conn.																				
Newport, R. I.					1															
Portland, Me.					14															
Providence, R. I.					1															
Salem, Mass.	2				3															
Tufts College, Mass.					1															
Wassbury, Conn.																				
Total, 1917.	67	25	1	4	45	610	2	183	69	295	135	23	0	1	203	58	340	209	23	0
Total, 1916.	27	14	17	7	194	744	0	53	12	367	180	11	0	0	54	10	349	249	10	0
Second district: NEW YORK, N. Y.																				
Total, 1917.	44	82	10	1	12	583	3	192	92	110	189	55	0	0	286	499	129	189	49	0
Total, 1916.	186	185	15	12	10	690	0	0	0	0	149	0	3	0	69	0	17	149	0	3
Third district:																				
BALTIMORE, MD.	78	35	3	5	33	428	1	72	3	86	104	13	2	1	102	12	166	105	14	2
Norfolk and Newport News, Va.	173	5	1	1	24															
Philadelphia, Pa.	3	7	6	3	7															
Total, 1917.	254	47	10	9	64	428	1	111	6	143	104	16	4	1	131	12	168	105	17	2
Total, 1916.	45	38	25	6	53	753	0	39	2	119	95	5	2	0	80	2	123	191	0	3

a Includes 35 emergency licenses.

b Includes 33 emergency licenses.

c Includes 10 emergency licenses.

d Includes 16 emergency licenses.

e Includes 14 emergency licenses.

f Includes 2 emergency licenses.



YEAR 1916, BY THE RADIO SERVICE, UNDER THE ACT (OF 1912) TO REGULATE RADIO COMMUNICATION—Continued.

Place of inspection or examination.	Stations inspected.				Amateur stations licensed.		Operators examined.				Operators licensed.			
	Ship—Voluntary equipment.	Ship for license.	Land.	Land for license.	General and restricted amateur.	Amateur.		Commercial.		Amateur.		Commercial.		
						First.	Second.	First.	Second.	First.	Second.	First.	Second.	
<b>Fourth district:</b>														
SAVANNAH, GA.			1	1	1									
CHARLESTON, S. C.			1	1	1									
JACKSONVILLE, FLA.			1	1	2									
KEY WEST, FLA.		5												
MIAMI, FLA.			1	1	1									
TAMPA, FLA.		1	1		7									
<b>Total, 1917.</b>	2	6	3	4	9			76						
<b>Total, 1916.</b>	0	0	0	0	0			86						
<b>Fifth district:</b>														
NEW ORLEANS, LA.														
ANNEVILLE, ILL.	54	19	3	2	11			79						
BEAUMONT, TEX.	1	1												
BURWOOD, ILL.			3		1									
GALVESTON, TEX.	5	2		1										
MOBILE, ALA.		1												
PORT ARTHUR, TEX.	7	1	1											
<b>Total, 1917.</b>	67	24	10	5	11			79						
<b>Total, 1916.</b>	65	23	3	18	2			101						
<b>Sixth district:</b>														
SAN FRANCISCO, CAL.														
DOUGLAS, ARIZ.	159	51	5	6	2			402						
HOLLISTER, CAL.				1										
LOS ANGELES, CAL.		2	4	1										
PHOENIX, ARIZ.														
SAN DIEGO, CAL.														
SAN PEDRO, CAL.	2	2		1										
<b>Total, 1917.</b>	161	55	10	11	3			402						
<b>Total, 1916.</b>	158	53	8	8	22			534						

Seventh district:																		
SEATTLE, WASH.																		
100	47	10	3	194	0	98	16	28	126	7	1	1	132	22	43	125	6	1
2	2	2	2	21	14	21	30	40	125	7	1	1	132	22	43	125	6	1
Portland, Ore.																		
Vancouver, Wash.																		
103	47	13	6	184	0	117	30	40	125	7	1	1	132	22	43	125	6	1
174	51	23	9	213	2	77	31	74	163	5	0	0	76	23	67	163	5	0
Total, 1917.																		
Eighth district:																		
DENVER, MICH.																		
66	15	3	2	669		54	20	46	263		2		17	32	55	543		4
5	4	1	1			17	9	36					6	10	25			
Buffalo, N. Y.																		
Cincinnati, Ohio.																		
6	1	3	1		1	11	12				1	1	7	18	27			
Frankfort, Mich.																		
Grand Haven, Mich.																		
Ladington, Mich.																		
2		1				22	11						4	21				
Pittsburgh, Pa.																		
Toledo, Ohio.																		
76	23	6	7	659	1	159	62	111	263	0	2	1	430	105	107	543	0	4
160	15	6	2	973	0	55	28	226	463	0	12	0	43	25	198	746	0	12
Total, 1917.																		
Total, 1916.																		
Ninth district:																		
CINCINNATI, ILL.																		
261	18	0	4	666	1	177	54	144	344	0	3	0	99	92	116	541	0	7
Carmel, Mich.																		
Davenport, Iowa.																		
Duluth, Minn.																		
Indianapolis, Ind.																		
Macineo Island, Mich.																		
Manistique, Mich.																		
Marquette, W. S.																		
1		1	1		3	10	7	63					2	6	43			
1		1	1		3	2	6						2	1				
Milwaukee, Wis.																		
Minneapolis, Minn.																		
Rock Island, Ill.																		
St. Louis, Mo.																		
261	20	3	10	666	1	205	77	309	344	0	3	0	104	109	253	541	0	7
371	30	3	0	76	1	108	20	195	434	0	8	0	65	32	136	606	0	7
Total, 1917.																		
Total, 1916.																		
SUMMARY.																		
First district.																		
67	26	1	4	610	2	188	60	295	135	23	0	1	205	68	360	209	23	0
44	83	10	1	123	3	102	92	110	189	56	0	0	268	99	126	189	49	0
Second district.																		
264	47	10	9	64	1	111	6	143	104	16	4	1	131	12	168	105	17	0
2	5	3	4	76	1	4	2	5	74	0	0	0	1	1	68	74	0	2
Third district.																		
67	24	10	5	11	79	10	56	13	77	12	0	4	75	6	13	77	9	1
Fourth district.																		
161	55	10	11	2	402	1	246	22	175	9	0	0	254	38	164	177	9	0
Fifth district.																		
102	47	13	6	6	184	0	117	30	49	125	7	1	132	22	43	125	6	1
Sixth district.																		
76	23	6	7	659	1	159	62	111	263	0	2	1	430	105	107	543	0	4
Seventh district.																		
261	20	3	10	666	1	205	77	309	344	0	3	0	104	109	253	541	0	7
Eighth district.																		
1,034	338	66	57	165	20	1,273	381	1,210	1,938	128	10	8	1,724	440	1,242	2,900	113	15
Grand total, 1917.																		
1,111	400	98	57	4,875	9	1,224	381	1,224	2,072	48	27	4	555	1,337	1,108	2,838	44	27
Grand total, 1916.																		

\* Includes 32 emergency licenses.  
 † Includes 83 emergency licenses.  
 ‡ Includes 124 emergency licenses.

\* Includes 4 emergency licenses.  
 • Includes 39 emergency licenses.  
 / Includes 12 emergency licenses.

a Includes 13 emergency licenses.  
b Includes 5 emergency licenses.  
c Includes 5 emergency licenses.

**ENFORCEMENT OF THE NAVIGATION LAWS.**

The enforcement of the navigation laws during the fiscal year 1917 proceeded as usual, although the work to a certain extent was affected by war conditions during the latter part. The Bureau employed the motor vessels *Dixie* and *Tarragon* in this work, together with 56 navigation inspectors and 14 radio inspectors.

During the year 7,569 violations of the navigation laws were acted on by the Department. This is a decrease of 256 cases from the number reported last year, which was the largest in the history of the Bureau.

The number of violations of the steamboat-inspection laws continues to increase, the total, 1,020, being 208 in excess of that for the previous year. This is due principally to the increased demand for licensed mates caused by the unusual increase in our foreign-going fleet, as well as the difficulty of securing at some of our ports properly certificated able seamen and lifeboat men. The decrease of 466 cases of violation of the motor-boat law undoubtedly is due to better compliance with the law by the owners of these vessels, as the number of inspections made during the year was about the same as on previous occasions.

The following table shows the work, by districts and laws violated, followed by comparison of the work in previous years:

VIOLATIONS OF NAVIGATION LAWS REPORTED BY THE VARIOUS COLLECTORS OF CUSTOMS, SHOWING THE LAWS VIOLATED, FISCAL YEAR ENDED JUNE 30, 1917, COMPARED WITH PREVIOUS YEARS.

Headquarters port.	Total.	Steamboat laws (R. S., 4399-4500).	Motor-boat law "Rules of road."	Surrendered license (R. S., 4325-4326).	Bills of health (Feb. 15, 1893). <sup>a</sup>	Seamen's act (Mar. 4, 1915).	Anchorage and St. Marys River rules.	Passenger act (Aug. 2, 1882).	Enrollment and license (R. S., 4336).	Entry and clearance (R. S., 2774, 4197).	Name on vessel (R. S., 4178).	Change of master (R. S., 4335).	Unloading.	Radio-communication laws.	Miscellaneous.
Baltimore.....	461	11	396	15	.....	3	.....	.....	2	.....	29	3	1	1	.....
Boston.....	427	171	155	50	.....	9	.....	13	.....	5	3	.....	16	5	14
Bridgeport.....	89	5	53	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Buffalo.....	87	36	50	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Charleston.....	50	.....	14	21	.....	.....	.....	.....	.....	1	6	.....	.....	.....	8
Chicago.....	283	18	246	3	.....	5	.....	.....	3	.....	4	2	.....	.....	2
Cleveland.....	161	128	7	16	.....	9	.....	.....	.....	.....	.....	.....	1	.....	2
Denver.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Des Moines.....	116	.....	99	3	.....	.....	.....	.....	.....	.....	14	.....	.....	.....	.....
Detroit.....	163	27	105	8	.....	2	.....	.....	.....	4	9	2	2	1	3
Duluth.....	138	71	58	4	.....	2	.....	.....	1	.....	.....	.....	2	.....	.....
Eagle Pass.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
El Paso.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Galveston.....	105	50	35	10	.....	.....	.....	.....	.....	1	5	2	.....	.....	2
Great Falls.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Honolulu.....	18	1	6	2	.....	.....	.....	2	.....	2	.....	.....	4	1	.....
Indianapolis.....	54	.....	47	1	.....	.....	.....	.....	.....	.....	6	.....	.....	.....	.....
Juneau.....	40	3	2	24	.....	.....	.....	.....	1	2	4	.....	1	1	2
Laredo.....	10	2	2	2	.....	.....	.....	.....	1	.....	.....	1	1	.....	1
Los Angeles.....	137	3	85	25	.....	.....	.....	.....	.....	4	7	1	1	1	.....
Louisville.....	128	7	102	10	.....	.....	.....	.....	1	.....	8	.....	.....	.....	.....
Memphis.....	84	21	33	17	.....	.....	.....	.....	1	.....	9	1	3	.....	.....
Milwaukee.....	82	29	40	1	.....	.....	.....	.....	.....	.....	8	1	2	.....	.....
Mobile.....	109	15	118	47	.....	2	.....	1	2	.....	3	4	2	.....	18
New Orleans.....	315	45	147	71	.....	4	.....	.....	4	.....	28	2	4	4	6
New York.....	1,292	97	1,049	60	.....	5	.....	5	12	1	47	2	4	.....	10
Nogales.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Norfolk.....	430	47	326	18	.....	1	.....	.....	.....	.....	20	1	1	.....	14
Ogdensburg.....	74	2	45	24	.....	.....	.....	.....	.....	1	.....	.....	1	.....	1
Omaha.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pembina.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Philadelphia.....	406	41	253	60	.....	5	.....	1	.....	.....	39	2	2	1	8
Pittsburgh.....	4	3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Port Arthur.....	93	53	7	20	.....	.....	.....	.....	.....	.....	9	1	1	.....	2
Portland, Me.....	145	19	101	20	.....	1	.....	.....	.....	.....	4	.....	.....	.....	.....
Portland, Oreg.....	130	2	119	3	.....	1	.....	.....	.....	2	2	1	.....	.....	.....
Providence.....	94	10	65	6	.....	.....	.....	.....	1	1	8	.....	.....	.....	2
Rochester.....	44	2	36	.....	.....	.....	.....	.....	.....	3	3	.....	1	.....	.....
St. Albans.....	68	.....	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis.....	348	10	307	24	.....	.....	.....	.....	.....	.....	4	1	1	.....	.....
St. Paul.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Salt Lake City.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco.....	196	33	70	22	.....	5	.....	6	5	6	17	2	4	4	22
San Juan.....	12	3	2	4	.....	.....	.....	.....	.....	1	.....	.....	2	.....	.....
Savannah.....	48	12	16	1	.....	12	.....	.....	.....	.....	6	.....	.....	1	.....
Seattle.....	318	16	138	100	.....	27	.....	.....	5	5	14	4	6	2	1
Tampa.....	547	24	184	56	.....	192	.....	.....	2	.....	55	5	6	.....	78
Wilmington, N. C.....	262	3	213	6	.....	.....	.....	.....	1	4	29	3	3	.....	.....
Total.....	7,569	1,020	4,060	770	.....	286	.....	29	42	43	400	41	74	22	182
1917 (48 ports).....	7,569	1,020	4,060	770	.....	286	.....	29	42	43	400	41	74	22	182
1916 (48 ports).....	7,325	812	5,126	943	.....	271	.....	1	59	28	331	35	67	43	90
1915 (48 ports).....	6,868	671	4,462	962	.....	.....	11	10	104	41	348	67	68	37	42
1914 (49 ports).....	6,730	768	4,838	631	.....	.....	8	25	41	26	153	59	90	36	45
1913 (107 ports).....	3,506	333	2,783	23	.....	23	8	24	10	88	26	1	40	152	.....
1912 (105 ports).....	3,634	165	3,119	96	3	.....	12	17	35	39	81	12	.....	62	.....
1911 (92 ports).....	2,268	182	1,811	23	41	.....	17	45	10	16	43	30	.....	60	.....
1910 (74 ports).....	1,070	262	488	17	52	.....	13	61	13	16	66	12	2	.....	76
1909 (64 ports).....	1,134	151	710	33	69	.....	3	21	14	7	59	.....	4	.....	68
1908 (73 ports).....	852	245	385	12	42	.....	6	21	23	18	30	7	2	.....	61
1907 (66 ports).....	684	209	92	85	35	.....	18	62	9	23	52	27	5	.....	63
1906 (77 ports).....	670	194	130	114	41	.....	13	27	10	6	49	5	.....	.....	72
1905 (63 ports).....	534	142	53	99	42	.....	18	21	26	7	20	11	28	.....	62
1904 (66 ports).....	706	184	93	101	48	.....	49	16	29	12	24	19	(c)	.....	131

<sup>a</sup> Bills of health cases transferred to Treasury Department July 24, 1911.

<sup>b</sup> Reports are now made by subports through the principal port of the district.

<sup>c</sup> Included under "Miscellaneous" in 1904 report.

The following table shows the work done by the various branches of the services engaged in the enforcement of the navigation laws:

NUMBER OF VIOLATIONS OF THE NAVIGATION LAWS ON WHICH PENALTIES WERE IMPOSED AND SOURCES OF THE REPORTS FOR FISCAL YEAR 1917.

Headquarters port.	Total.	Coast guard.	Tarragon.	Dixie.	Local inspectors.	Radio inspectors.	Customs officers.	Navigation inspectors.	Cases reported under allotments.
Baltimore.....	469	5	185	119	7		16	127	127
Boston.....	431	33		103	181	5	109		
Bridgeport.....	90	31		24	8		32		
Buffalo.....	87			4	36		1	46	46
Charleston.....	45	4	2				42		
Chicago.....	286	205			21		24	36	36
Cleveland.....	173	3			182		38		
Denver.....									
Des Moines.....	109	67					42		39
Detroit.....	173	112			30		31		
Duluth.....	133						104	29	29
Eagle Pass.....	1						1		
El Paso.....									
Galveston.....	103	24	1		2		76		
Great Falls.....									
Honolulu.....	20				1		19		
Indianapolis.....	54	8					12	34	34
Juneau.....	41	9			3		29		
Laredo.....	10	2					8		
Los Angeles.....	135				1		134		102
Louisville.....	131	12			13		62	44	44
Memphis.....	77				18		31	23	23
Milwaukee.....	84	43	17		27		9		
Mobile.....	109	5	17		13		74		
New Orleans.....	314	33	124		22	3	132		
New York.....	1,291	252	554	235	71		133	46	46
Nogales.....	1						1		
Norfolk.....	425	23	55	231	40		39	37	37
Ogdensburg.....	72				1		71		44
Omaha.....									
Pembina.....									
Philadelphia.....	396	3	7	46	9		187	144	144
Pittsburgh.....	4				3		1		
Port Arthur.....	91	1	13		7		70		
Portland, Me.....	145	7		90	15		24		
Portland, Oreg.....	126				1		125		113
Providence.....	95	22		3	6		22	42	42
Rochester.....	44						44		
St. Albans.....	68						68		68
St. Louis.....	334	80			10		213	31	31
St. Paul.....									
Salt Lake City.....									
San Francisco.....	194	116			3	4	71		3
San Juan.....	13						13		
Savannah.....	50	1	5		10		34		
Seattle.....	329	90			12	1	226		126
Tampa.....	549	15	79		13		442		
Wilmington, N. O.....	260	44	192		1		28		
Total—									
1917 (43 ports).....	7,565	1,255	1,234	364	712	13	2,333	664	1,159
1916 (43 ports).....	7,895	1,333	987	984	590	36	2,376	1,089	1,175
1915 (43 ports).....	6,950	1,380	1,425		361	34	2,061	909	1,421
1914 (49 ports).....	6,720	922	1,762		734	27	3,275		1,325

The foregoing statement of the work done by the various inspection services is based on reports made by collectors of customs on Catalogue 1078 and is approximately correct.

The motor vessels *Tarragon* and *Dixie*, operated by the Bureau, reported 2,098 cases, as against 1,255 cases reported by the entire Coast Guard service. Since the declaration of war on April 6 the Coast Guard fleet, however, has operated with the Navy.

The following table shows the work of the various customs ports for 14 years:

## COMPARATIVE STATEMENT OF CASES OF VIOLATIONS OF THE NAVIGATION AND STEAMBOAT-INSPECTION LAWS REPORTED BY OFFICERS OF CUSTOMS, 1904-1917.

Port.	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	Total
Baltimore.....	65	30	14	34	21	43	49	114	129	294	219	396	312	461	2,181
Boston.....	27	33	40	15	8	18	34	132	327	67	949	440	412	427	2,920
Bridgeport.....	8	7	12	9	9	4	13	206	423	30	134	118	54	89	1,116
Buffalo.....	1	3	3	5	10	8	33	9	75	64	3	42	144	87	486
Charleston.....	2	5	21	3	2	4	1	4	13	154	91	39	50	380	580
Chicago.....	8	7	8	7	21	5	70	138	55	35	105	178	389	283	1,309
Cleveland.....	14	14	20	20	27	10	32	114	66	76	90	104	218	161	966
Des Moines.....	1	1	2	3	5	4	1	3	3	160	85	4	116	383	583
Detroit.....	33	22	41	48	28	86	161	60	251	221	112	293	441	163	1,970
Duluth.....	24	16	15	16	15	14	46	9	13	15	17	62	79	138	469
Eagle Pass.....								1	8	28	2			1	35
El Paso.....															
Galveston.....	7	5	8	15	5	9	1	6	2	39	49	49	50	106	380
Great Falls.....			1												1
Honolulu.....	6	2	8		7	17	20	14	14	11	15	14	18	18	164
Indianapolis.....					2			7	23	5	1	5	109	54	206
Juneau.....	18	21	10	22	9	8	17	113	67	27	41	43	33	40	469
Laredo.....	1							1	16	5	14	2	7	10	86
Los Angeles.....		8	5	5	53	4	26	65	36	28	79	182	172	137	794
Louisville.....		1	2	5			1	14	24	6	41	58	63	128	343
Memphis.....	3	3	7	4	4	3	8	10	12	9	10	52	94	84	298
Milwaukee.....		6	9	4	14	19	13	16	22	16	16	8	133	82	360
Mobile.....	21	35	32	23	6	9	41	36	40	30	157	107	106	109	752
New Orleans.....	11	15	38	21	21	16	24	51	71	73	218	173	173	815	1,224
New York.....	164	132	160	124	260	638	174	292	363	330	1,013	622	1,250	1,262	6,799
Nogales.....															
Norfolk.....	43	13	21	16	170	66	42	214	121	489	235	335	581	430	2,727
Ogdensburg.....	5	4	2	4	4	6	6	13	26	20	57	40	92	74	352
Omaha.....															
Pembina.....															8
Philadelphia.....	25	12	26	16	10	8	17	25	28	164	378	807	483	406	2,465
Pittsburgh.....					3	5	1	24	1	21	13	27	27	4	104
Port Arthur.....				6	4	3	5	28	35	10	126	33	58	93	411
Portland, Me.....	7	9	5	7	14	13	26	86	167	51	78	566	241	145	1,405
Portland, Oreg.....	7	7	11	5	2	3	6	7	125	331	354	273	220	130	1,480
Providence.....	1	2	14	9	9	13	7	79	70	20	130	21	126	94	594
Rochester.....			4	1	2	1	7	13	23	42	34	23	42	44	246
St. Albans.....										4	1	54	3	38	165
St. Louis.....			1		3	3	8	30	88	20	109	186	154	348	950
St. Paul.....	1	1	1			2		3			5	1	5		19
Salt Lake City.....															
San Francisco.....	6	20	11	73	25	20	70	103	64	107	260	446	276	196	1,677
San Juan.....	11	4	4	3	13	3	9	9	25	18	28	23	11	12	178
Savannah.....	5	1	7	1	6	2	1	2	7	6	98	73	82	43	344
Seattle.....	133	54	72	87	33	20	19	74	108	59	381	306	409	318	2,087
Tampa.....	27	33	46	54	29	27	80	135	682	364	669	314	570	547	3,577
Wilmington, N. C.....	4	3	5	1	8	11	5	23	20	373	104	208	137	262	1,162
Total (47 ports).....	706	524	670	684	852	1,134	1,070	2,263	3,634	3,506	6,720	6,868	7,826	7,560	44,080

## MOTOR VESSEL "DIXIE."

This vessel, which went into commission July 1, 1915, and since that time patrolled the waters of the New England coast as far south as New York during the summer and Chesapeake Bay and adjacent waters in the winter in connection with the supervision of the oyster fleet, has been equipped with two new standard 150-horsepower engines and at present is in use by the Navy Department as a dispatch boat. With her new engines she has developed a speed of about 18 miles an hour and is especially suited for naval work.

## MOTOR VESSEL "KILKENNY."

To replace the motor vessel *Dixie*, turned over to the Navy Department for the period of the war, the Bureau arranged to purchase the motor boat *Kilkenny*, of 52 gross and 45 net tons. She is 79.4 feet on the water line with a beam of 14.4 feet. Although the owner, Mr. Edward Crozer, of Philadelphia, had a cash offer of \$15,000 for the vessel, through patriotic desire to assist the Government, he offered her for \$8,700 and later canceled the voucher giving the vessel and her equipment to the Department entirely without cost.

**MOTOR VESSEL "TARRAGON."**

The *Tarragon* has continued her work of inspection of motor boats and larger vessels, reporting during the year 1,234 violations of the law, nearly one-sixth of the entire number of violations reported during the year from all sources. The vessel does much work in preventing the overcrowding of passenger vessels, seeing that the rules of the road are complied with, proper lights carried, etc., in addition to her motor-boat work.

**REGULATION OF MOTOR BOATS.**

The Bureau has continued to bring to the attention of motor-boat owners the act of June 9, 1910, encouraging voluntary compliance with the law, as the work of inspection and imposition of penalties alone is not sufficient to accomplish the purpose. Motor-boat publications, clubs, and organizations are cooperating with the Department, and the reduction in the number of violations discovered is evidence that the work is securing results.

**MOTOR-BOAT LEGISLATION.**

The following recommendations in the report for last year are renewed, the excise motor-boat tax under the war revenue act of October 3, 1917, requiring enactment of the numbering bill already passed by the Senate:

It does not seem feasible or necessary to apply in their entirety the laws and regulations governing steam vessels (of which there are about 8,000 subject to the inspection laws), to thirty times that number of motor boats. The cost of administration would be very large and the need does not, to my mind, justify the expenditure. At the same time it does not seem right that there should be no restriction whatever upon the number of passengers that can be carried upon the motor boat beyond the requirement that there must be a life preserver for each person carried. That requirement in itself is a reasonable regulation in the case of small boats. When, however, as is frequently the case, 25, 50, or as many as 100 persons are crowded on these small boats, serious risks are incurred, which it is the part of prudence to diminish by legislation.

The passage of a law is suggested providing that motor boats shall not carry passengers in excess of an arbitrary fixed number, unless they have been subject to the inspection prescribed for the like type of steam vessels and unless those in charge of them have been licensed after examination in the same manner as the corresponding officers on steam vessels are licensed. Such legislation should not take tonnage as its basis but should be based on the length of the vessel over all, which is much more readily ascertained. Legislation along these lines should consider also the nature of the waters on which the boat is employed. After consultation with those competent to express correct and disinterested opinions on the subject, it is hoped to submit a draft of a bill for your consideration.

The advantages of a Federal system of numbering motor boats were presented at some length in last year's report by the officers more directly concerned with the administration of the motor-boat law. The States have found it necessary to establish systems of numbering automobiles, and for some reasons a Federal system of numbering motor boats may be necessary. The following measure seems as simple as can be devised, if Congress shall deem it necessary to take up the subject:

**A BILL** To require numbering and recording of undocumented vessels.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That every undocumented vessel, operated in whole or in part, by machinery, owned in the United States and found on the navigable waters thereof, except public vessels and vessels not exceeding sixteen feet in length measured from end to end over the deck, excluding sheer, equipped with detachable motors, shall be numbered. Such numbers shall be not less in size than three inches and painted

or attached to each bow of the vessel in such manner and color as to be distinctly visible and legible.

SEC. 2. The said numbers, on application of the owner or master, shall be awarded by the collector of customs of the district in which the vessel is owned and a record thereof kept in the customhouse of the district in which the owner or managing owner resides. No numbers not so awarded shall be carried on the bows of such vessel.

SEC. 3. Notice of destruction or abandonment of such vessels or change in their ownership shall be furnished within ten days by the owners to the collectors of customs of the districts where such numbers were awarded. Such vessels sold into another customs district may be numbered anew in the latter district.

SEC. 4. The penalty for violation of any provision of this Act shall be ten dollars, for which the vessel shall be liable and may be seized and proceeded against in the district court of the United States in any district in which such vessel may be found. Such penalty on application may be mitigated or remitted by the Secretary of Commerce.

SEC. 5. The Secretary of Commerce shall make such regulations as may be necessary to secure proper execution of this Act by collectors of customs and other officers of the Government.

This Act shall take effect six months after its passage.

Without regulation certain motor-boat owners carry more passengers for hire than their vessels will accommodate with safety. The number of people that may be carried on motor boats is now restricted only by the rule that such boats must have a life preserver for every person on board. The following bill is intended to require every motor boat, carrying 20 or more passengers for hire, to have its hull and machinery inspected and the operator in charge licensed under circumstances which will establish the fact that he is qualified to navigate properly such a vessel. Perhaps the most beneficial feature of the bill, however, is that part which enables the local inspectors of steam vessels to limit the number of passengers over 20 which such boats may carry with prudence and safety.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That section forty-four hundred and twenty-six of the Revised Statutes as amended by the Act of May sixteenth, nineteen hundred and six, is hereby amended so as to read:

"SEC. 4426. (a) The hull and boilers of every ferryboat, canal boat, yacht, or other small craft of like character propelled by steam, shall be inspected under the provisions of this title. Such other provisions of law for the better security of life as may be applicable to such vessel shall, by the regulations of the Board of Supervising Inspectors, also be required to be complied with before a certificate of inspection shall be granted, and, UNLESS OTHERWISE PROVIDED FOR BY LAW, no such vessel shall be navigated without a licensed engineer and a licensed pilot: *Provided, however,* That in open steam launches of ten gross tons and under, one person, if duly qualified, may serve in the double capacity of pilot and engineer.

"(b) All vessels above fifteen gross tons carrying freight or passengers for hire, but not engaged in fishing as a regular business, propelled by MACHINERY OTHER THAN BY STEAM, shall be, and are hereby, made subject to all the provisions of PARAGRAPH (A) OF THIS SECTION, relating to the inspection of hulls and boilers and requiring engineers and pilots, and to the rules and regulations established thereunder.

"(c) THAT EVERY VESSEL PROPELLED BY MACHINERY OTHER THAN BY STEAM AND EVERY STEAM VESSEL NOT MORE THAN SIXTY-FIVE FEET IN LENGTH FROM END TO END OVER THE DECK, EXCLUDING SHEER, WHILE CARRYING TWENTY OR MORE PASSENGERS FOR HIRE, IN ADDITION TO THE INSPECTION ALREADY PROVIDED BY LAW, SHALL BE INSPECTED AS TO THE HULL AND GENERAL CONDITION OF THE OPERATING MACHINERY, AND THE LOCAL INSPECTORS, WHERE CERTIFICATES OF INSPECTION ARE NOT NOW PROVIDED FOR BY LAW, SHALL ISSUE TO SUCH VESSELS CERTIFICATES OF APPROVAL, IN ACCORDANCE WITH THE FORM AND REGULATIONS PRESCRIBED BY THE BOARD OF SUPERVISING INSPECTORS. ALL CERTIFICATES OF INSPECTION AND OF APPROVAL ISSUED UNDER AUTHORITY OF THIS SECTION SHALL STATE THE NUMBER OF PASSENGERS SUCH INSPECTED OR APPROVED VESSELS CAN CARRY WITH PRUDENCE AND SAFETY.

"(d) THE OPERATORS OF SUCH VESSELS, EXCEPT VESSELS PROPELLED BY MACHINERY OTHER THAN BY STEAM ABOVE FIFTEEN GROSS TONS AND OVER SIXTY-FIVE FEET IN LENGTH FROM END TO END OVER THE DECK, EXCLUDING SHEER, WHILE CARRYING TWENTY OR MORE PASSENGERS FOR HIRE, SHALL BE LICENSED BY THE LOCAL



INSPECTORS OF STEAM VESSELS AFTER AN EXAMINATION COVERING KNOWLEDGE OF THE RULES OF THE ROAD, ABILITY TO DISTINGUISH COLORS, GENERAL KNOWLEDGE OF MOTOR ENGINES AND MACHINERY, AND OF THE NAVIGATION OF WATERS IN WHICH THE VESSEL IS TO BE USED.

"(E) THE CERTIFICATES OF APPROVAL AND THE LICENSES OF SUCH OPERATORS SHALL BE KEPT ON BOARD WHILE SUCH VESSELS ARE CARRYING TWENTY OR MORE PASSENGERS, AND SHALL BE EXHIBITED ON REQUEST OF ANY OFFICER CONCERNED IN THE ENFORCEMENT OF THE NAVIGATION LAWS.

"(F) IF ANY VESSEL SUBJECT TO THIS SECTION IS NAVIGATED WITHOUT COMPLYING WITH THE REQUIREMENTS THEREOF, OR CARRIES PASSENGERS FOR HIRE IN EXCESS OF THE NUMBER ALLOWED BY HER CERTIFICATE OF INSPECTION OR OF APPROVAL, SUCH VESSEL SHALL BE LIABLE TO THE UNITED STATES IN A PENALTY OF FIVE HUNDRED DOLLARS FOR EACH OFFENSE, FOR WHICH SUM SUCH VESSEL MAY BE SEIZED AND PROCEEDED AGAINST, BY WAY OF LIBEL, IN THE DISTRICT COURT OF THE UNITED STATES OF THE DISTRICT WHERE THE OFFENSE OCCURRED, OR WHERE SUCH VESSEL MAY BE FOUND.

"(G) ALL COLLECTORS OR OTHER CHIEF OFFICERS OF THE CUSTOMS AND ALL INSPECTORS WITHIN THE SEVERAL DISTRICTS SHALL ENFORCE, UNDER THE DIRECTION OF THE SECRETARY OF COMMERCE, THE PROVISIONS OF THIS SECTION."

The portions of the above bill printed in small capitals are new.

#### PREVENTION OF OVERCROWDING OF PASSENGER VESSELS.

During the fiscal year this work continued with little change from that of the previous year. There were 11,958 counts of 5,172,348 passengers going on vessels. This is an increase of about 58,000 passengers over last year. These inspectors also reported 654 violations of the navigation laws other than overcrowding of vessels.

The following table shows by ports 331 occasions on which our inspectors prevented more passengers going on board after the capacity had been reached. The safety of 267,017 passengers was involved, as undoubtedly on most of these occasions there would have been an overcrowding of the vessel had the inspectors not been present.

SHUT-OFFS, BY MONTHS, DURING THE FISCAL YEAR 1917.

Port.	July.		August.		Septem-ber.		Novem-ber.		Decem-ber.		March.		May.		June.		Total.	
	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.
Baltimore....	28	23,226	6	4,750	3	3,050	1	500			21,538				22,384	42	35,448	
Boston.....			17	15,083	4	1,856										21	16,939	
Buffalo.....	2	1,300														2	1,300	
Charleston, S. C.....	1	300														1	300	
Chicago.....	71	30,898	24	8,066	1	202									3	616	96	39,782
Cleveland....	40	36,156	17	12,611	2	1,915										59	50,682	
Detroit.....	22	50,883	11	26,568											11,800	34	79,251	
Duluth.....	5	3,196														5	3,196	
Indianapolis..	1	900														1	900	
Louisville....	2	625	1	356												4	1,337	
Memphis.....	1	600			1	272									1	356	3	1,872
Norfolk.....	2	988	6	3,011	1	416									11,000	9	4,413	
Ogdensburg..	2	700														2	700	
Philadelphia..	1	1,189														1	1,189	
Portland, Me.	1	400	4	802												5	1,202	
Providence....	8	4,394	15	13,202	3	4,610										26	22,206	
Rochester....	1	670														1	670	
Seattle.....	11	3,685			1	280										12	3,965	
Tampa.....									1	230						1	230	
St. Albans...													1	725		1	725	
Galveston....													2	710		2	710	
Total.....	199	160,108	101	84,449	16	12,601	1	500	1	230	21,538		31,436		86,186	331	267,017	

The above totals do not include the report from New York, which shows that during the fiscal year 23,144 intending passengers were shut off on a total of 82 trips.

The following table shows the work in detail by both the navigation and customs officers:

NUMBER OF COUNTS AND THE NUMBER OF PASSENGERS INVOLVED IN PREVENTING OVERCROWDING OF PASSENGER VESSELS DURING FISCAL YEAR 1917.

Port.	Navigation.		Customs.		Total.	
	Counts.	Passengers.	Counts.	Passengers.	Counts.	Passengers.
Baltimore.....	1,719	838,469	5	1,733	1,724	840,202
Boston.....	2	2,154	875	648,744	877	650,898
Bridgeport.....			5	3,861	5	3,861
Buffalo.....			3,023	829,053	3,023	829,053
Charleston, S. C.....			26	11,218	26	11,218
Chicago.....	897	269,633	127	45,426	1,024	315,058
Cleveland.....	1,376	259,534	389	318,960	1,765	578,494
Detroit.....	674	891,171	69	87,990	743	979,161
Des Moines.....			1	1,242	1	1,242
Duluth.....	87	15,616	142	43,998	229	59,614
Galveston.....			90	6,935	90	6,935
Indianapolis.....	128	41,010	2	854	130	41,864
Louisville.....	158	36,838	119	59,442	277	96,280
Memphis.....	177	63,916	4	2,515	181	66,431
Mobile.....			10	2,342	10	2,342
New Orleans.....			3	1,132	3	1,132
Norfolk.....	68	22,667	28	10,090	96	32,757
Ogdensburg.....			33	12,686	33	12,686
Philadelphia.....	242	151,998	71	34,724	313	186,722
Port Arthur.....			31	307	31	307
Portland, Me.....	487	73,318	1	112	488	73,430
Portland, Oreg.....			14	2,388	14	2,388
Providence.....	607	282,975	38	9,563	645	292,538
St. Albans.....			46	17,987	46	17,987
Seattle.....			182	69,303	182	69,303
Tampa.....			2	445	2	445
Total.....	6,622	2,949,299	5,336	2,223,049	11,958	5,172,348
Total for fiscal year 1916.....	8,359	3,244,953	5,451	1,867,814	13,810	5,112,351

The above totals do not include the report from New York, which shows a total number of counts for the fiscal year of 3,608, the number of passengers involved being 1,624,083.

#### PASSENGER ACT OF 1882.

The number of ships of the American trade subject to the passenger act of 1882 continues to decline with the decrease in the ocean passenger trade and the heavy increase in exports on cargo boats.

During the past fiscal year passenger ships on 630 voyages brought 147,493 steerage passengers to the United States, compared with 720 voyages carrying 154,057 passengers in the fiscal year 1916; 956 voyages carrying 211,057 passengers in 1915; and 1,797 voyages carrying 1,016,453 passengers in 1914.

#### ADMEASUREMENT OF VESSELS.

The unprecedented increase in shipbuilding in the United States renders the accurate measurement of the tonnage of vessels building even more important than hitherto. At present, under laws administered by the Department of Commerce, employees of the Treasury Department at the customs ports measure vessels. Except at a very few ports, these men are primarily customs inspectors detailed as occasion requires to measure vessels. This system does not

secure uniformity and accuracy of measurement, which is necessary. By cooperation with the Treasury Department it is hoped that at a later date a system devised to secure more satisfactory results may be put into operation.

Respectfully,

EUGENE TYLER CHAMBERLAIN,  
*Commissioner.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*

NOTE.—The report of the Commissioner of Navigation, as separately published, contains also the following appendixes and statistical tables:

## APPENDIXES.

- (A) Reports of shipping commissioners for year ended June 30, 1917—(1) Shipments, discharges, and expenditures; (2) Shipments and reshipments of seamen; (3) Number of men discharged; (4) Nationality of seamen; (5) Failures of seamen to join American vessels; (6) Men shipped to be discharged in foreign ports; (7) Allotments of wages; (8) Seamen shipped and discharged by collectors.
- (B) Wages of seamen—(1) Average monthly wages paid in the American merchant marine, year ended June 30, 1917; (2) Average monthly wages paid to able seamen on American vessels, 1895-1917; (3) Average monthly wages paid to first mates on American vessels, 1895-1917; (4) Average monthly wages paid to firemen and first engineers on American steam vessels, 1895-1917.
- (D) Tonnage tax—Law and collections—(1) Tonnage-tax collections, 1884-1917; (2) Tonnage tax collected, year ended June 30, 1917, by customs districts; (3) Tonnage tax collected, year ended June 30, 1917, by nationality of vessels; (4) Tonnage tax collected, year ended June 30, 1917, by countries from which the vessels entered.
- (F) The world's tonnage, motive power, and materials of construction—(1) World's tonnage, based on official returns, 1850-1911 (from Return on Progress of British Shipping for 1912); (2) Number and net and gross tonnage of steam and sailing vessels as recorded by the Bureau Veritas for 1916-17; (3) Number and net and gross tonnage of steam and sailing vessels of over 100 tons, of the several countries of the world, as recorded in Lloyd's register for 1916-17; (4) Motive power and chief materials of construction of the world's merchant marine, 1890-1916 (Lloyd's); (5) Total number and tonnage of steam vessels (over 100 tons) and sailing vessels (over 50 tons), 1890-1916 (Bureau Veritas); (6) Construction—Vessels built in the world (over 100 tons) according to Lloyd's (including vessels not recorded in Lloyd's) during 10 recent years; (7) The world's shipbuilding in 1915, excluding warships (Lloyd's summary); (8) Merchant vessels under construction June 30, 1916 (Lloyd's); (9) Number, tonnage, and nationality of vessels totally lost, condemned, etc., during the year 1914, as reported up to July 12, 1915; also the number and tonnage of steam and sailing vessels owned in each country.
- (G) Progress of British, German, and Japanese shipping.
- (I) Square-rigged American vessels.
- (K) Miscellaneous—(1) Foreign carrying trade of the United States, 1821-1917; (2) Tonnage of American and foreign vessels entered and cleared in the foreign trade of the United States, fiscal years 1821-1917; (3) Imports and exports of United States, by nationality of vessels, fiscal years 1914-1917; (4) Imports and exports of United States by water, fiscal years 1914-1917; (7) Nationality of members of seamen's unions.

## STATISTICAL TABLES.

- (10) Documented sailing and steam tonnage constituting the total merchant marine of the United States, 1789-1916.
- (10a) Number and gross tonnage of canal boats and barges documented in the United States, in specified years, 1868-1916.
- (10b) Number and gross tonnage of sailing vessels, steam vessels, canal boats, and barges documented on the northern lakes, in specified years, 1868-1916.
- (16) Documented tonnage of the United States merchant marine employed in the foreign trade, the coasting trade, and the fisheries, 1789-1916.
- (23) Class, number, and gross tonnage of vessels built in the United States and documented, 1797-1916.
- (24) Number and gross tonnage of vessels built in the United States and documented, by geographic divisions, 1857-1916.
- (25) Tonnage of vessels of the United States which have been built, admitted to registry by acts of Congress, etc., and those which have been lost, abandoned, sold to aliens, etc., 1813-1916.

- (26) Class, number, and gross tonnage of documented yachts of the United States, by ports, June 30, 1916.
- (27) Class, number, and gross tonnage of documented metal yachts of the United States, by ports, June 30, 1916.
- (28) Class, number, and gross tonnage of yachts built in the United States and documented during year ended June 30, 1916, by customs districts.
- (29) Class, number, and gross tonnage of metal yachts built in the United States and documented during year ended June 30, 1916, by ports.
- (30) Class, number, and gross tonnage of documented yachts lost, abandoned, sold to aliens, etc., year ended June 30, 1916.

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**REPORT**  
**OF THE**  
**CHIEF OF THE APPOINTMENT DIVISION**

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**1017**



# REPORT OF THE CHIEF OF APPOINTMENT DIVISION.

DEPARTMENT OF COMMERCE,  
APPOINTMENT DIVISION,  
*Washington, September 11, 1917.*

SIR: There is submitted herewith my annual report as Chief of the Appointment Division for the fiscal year ended June 30, 1917:

## STATISTICS RELATING TO THE PERSONNEL.

The accompanying table shows by bureaus the number of permanent positions in the Department on July 1, 1917, and the increase or decrease in each bureau as compared with July 1, 1916. The figures do not include temporary appointments, nor do they include the following appointments or employments not made by the head of the Department: Persons engaged in rodding, chaining, recording, heliotroping, etc., in field parties of the Coast and Geodetic Survey; temporary employments in field operations of the Bureau of Fisheries; mechanics, skilled tradesmen, and laborers employed under authority of Schedule A, Subdivision I, section 12, of the civil-service rules in the Lighthouse Service. Enlisted men on vessels of the Coast Survey in the Philippine Islands and officers and men of the Navy Department employed on vessels of the Bureau of Fisheries are also excluded. The total of these excluded miscellaneous employments and enlistments is approximately 4,524. At the close of the fiscal year there were 466 employees in the service of the Department serving under temporary appointment or employment.

Bureau.	Statutory.	Nonstatutory.	Total.	In District of Columbia.	Outside District of Columbia.	Increase (+) or decrease (-).
Office of the Secretary.....	172	.....	172	172	.....	+ 1
Bureau of the Census.....	563	684	1,247	a 591	656	- 13
Bureau of Foreign and Domestic Commerce.....	113	120	233	129	104	+ 35
Bureau of Standards.....	278	240	518	448	70	+ 96
Bureau of Fisheries.....	418	34	452	80	372	+ 18
Bureau of Lighthouses.....	55	5,658	b 5,713	38	5,675	+ 15
Coast and Geodetic Survey.....	289	501	790	c 315	475	+ 20
Bureau of Navigation.....	c 43	124	167	34	133	+ 6
Steamboat-Inspection Service.....	246	75	321	12	309	+ 19
Total.....	2,177	7,436	9,613	1,819	7,794	+196

a Employees engaged in work in the field for a part of each year, with headquarters in Washington, are treated as within the District of Columbia.

b Includes the following positions, appointment to which is not made by the head of the Department: 298 (232 classified competitive and 66 classified excepted) mechanics, skilled tradesmen, and laborers employed in field construction work in the Lighthouse Service and work of a similar character at the general lighthouse depot at Tompkinsville, N. Y.; 1,525 laborers in charge of post lights; and 1,297 members of crews of vessels.

c Includes 2 stenographers and typewriters authorized by law, and not to be employed exceeding 6 months.

NOTE.—In another part of this report reference is made to the additional emergency force in the Department employed on work in connection with war conditions and not included in the above table.



## CHANGES IN THE PERSONNEL.

The following tables give a summary of changes in the personnel of the Department for the fiscal year ended June 30, 1917:

## APPOINTMENTS, PROMOTIONS, AND REDUCTIONS.

Bureau.	Appointments. *						Promo- tions.	Reduc- tions.
	Permanent.				Tempo- rary.	Grand total.		
	Com- peti- tive.	Ex- cepted.	Unclassi- fied.	Total.				
Office of the Secretary.....	34	3	3	40	9	49	45	-----
Bureau of the Census.....	57	10	141	208	201	409	108	1
Foreign and Domestic Commerce.....	41	79	-----	120	67	187	66	8
Bureau of Standards.....	163	-----	14	177	161	338	219	3
Bureau of Fisheries.....	62	6	14	82	69	151	65	8
Bureau of Lighthouses.....	341	54	-----	395	233	628	590	118
Coast and Geodetic Survey.....	74	1	2	77	94	171	141	71
Steamboat-Inspection Service.....	53	2	-----	55	36	91	26	-----
Bureau of Navigation.....	38	4	6	48	74	122	31	1
Total.....	863	159	180	1,202	944	2,146	1,526	299

\* Includes appointments of the following character: Presidential, by selection from civil-service certificates, under Executive order, to excepted positions, by reinstatement, and by reason of transfer within the Department or from other departments or independent establishments.

† Includes 447 temporary increases in the personnel of the vessels of the Lighthouse Service.

## SEPARATIONS AND MISCELLANEOUS CHANGES.

Bureau.	Separations.*						Miscellaneous changes.†
	From permanent positions.				From temporary positions.	Grand total.	
	Competitive.	Ex-cepted.	Unclassified.	Total.			
Office of the Secretary.....	36	1	4	41	7	48	9
Bureau of the Census.....	53	7	152	212	100	312	11
Foreign and Domestic Commerce.....	26	26	2	53	46	99	21
Bureau of Standards.....	110	-----	6	116	88	204	14
Bureau of Fisheries.....	66	7	16	89	24	113	21
Bureau of Lighthouses.....	364	50	-----	414	122	536	66
Coast and Geodetic Survey.....	64	-----	2	66	40	106	6
Steamboat-Inspection Service.....	26	1	-----	27	18	45	26
Bureau of Navigation.....	33	-----	10	43	35	78	9
Total.....	778	91	192	1,061	490	1,551	129

\* Includes separations by reason of resignations, discontinuances, removals, deaths, transfers within the Department, and transfers from the Department to other departments or independent establishments.

† Includes reappointments by reason of change of station, name, designation, or appropriation, extensions of temporary appointments, changes from temporary to permanent status, etc.

## PROMOTIONS.

The Department has continued to carry out its fixed policy of affording employees every possible means of advancement within its own limits and of not filling vacancies in the higher grades by transfer from other branches of the service so long as there are employees of its own who are eligible and capable of efficiently performing the duties of the higher positions. During the past fiscal year the Department authorized 1,526 promotions and increases in pay, as compared to 1,376 and 838 authorized during the fiscal years ended June 30, 1916, and June 30, 1915, respectively, while there were only 10 transfers made from other departments or independent offices at more than the usual entrance salaries, and in each case it was satisfactorily shown that the vacancies could not be adequately filled by promotion or transfer within the Department.

The Department has assented to the request of the Civil Service Commission for the elimination of relative efficiency ratings from marks obtained in promotion examinations; and in future no employee will be admitted to examination whose efficiency is below 85 per cent, and no employee will be eligible for promotion who fails to attain at least 75 per cent in the scholastic tests. Forty employees of the Department in the minor-clerk and subclerical grades were competitors in the various promotion examinations conducted by the commission during the past year, with the following results:

Examination.	Passed.	Failed.
Clerk, first grade.....	1	15
Typewriter.....	4	11
Clerk, minor.....	5	4
Total.....	10	30

\* 7 have since been promoted.

## LEAVES OF ABSENCE, FURLOUGHS, ETC.

The following table shows by bureaus the total and average amount of annual and sick leave, stated separately and together, taken by the employees of the Department in the District of Columbia, arranged according to sex, during the calendar year 1916. This table also shows the average leave, by bureaus, as compared with 1915. A further comparison indicates that the averages for 1916 show an increase of 0.23 day of annual leave and an increase of 0.19 day of sick leave over the averages for 1915.

TOTAL AND AVERAGE AMOUNT OF ANNUAL <sup>a</sup> AND SICK LEAVE, BY BUREAUS, STATED SEPARATELY AND TOGETHER, TAKEN BY THE EMPLOYEES OF THE DEPARTMENT IN THE DISTRICT OF COLUMBIA, ARRANGED ACCORDING TO SEX, DURING THE CALENDAR YEAR 1916, AND THE AVERAGE LEAVE FOR 1915.

## MALE.

Bureau.	Num-ber.	Annual leave.		Sick leave.		Total.		Average, 1915.
		Days.	Average.	Days.	Average.	Days.	Average.	
Office of the Secretary.....	97	2,645	27.27	612½	6.32	3,258½	33.59	32.81
Bureau of the Census.....	288	8,408	29.19	2,180	7.57	10,588	36.76	35.33
Bureau of Foreign and Domestic Commerce.....	88	2,532	28.77	609	6.92	3,141	35.69	34.67
Bureau of Standards.....	267	7,206	26.99	1,158½	4.34	8,364½	31.33	31.91
Bureau of Fisheries.....	51	1,226	24.24	238½	4.68	1,474½	28.92	28.54
Bureau of Lighthouses.....	31	918	29.61	192	6.19	1,110	35.80	36.09
Coast and Geodetic Survey.....	165	4,632	28.07	951	5.76	5,583	33.83	33.15
Bureau of Navigation.....	19	539	28.37	61	3.21	600	31.58	34.13
Steamboat-Inspection Service.....	9	240	26.66	25	2.78	265	29.44	28.82
Total and average.....	1,015	28,356	27.94	6,028½	5.94	34,384½	33.88	33.51

## FEMALE.

Office of the Secretary.....	47	1,287	27.38	462½	9.84	1,749½	37.22	32.01
Bureau of the Census.....	252	7,518	29.83	2,711½	10.76	10,229½	40.59	40.35
Bureau of Foreign and Domestic Commerce.....	14	410	29.28	114½	8.18	524½	37.46	35.59
Bureau of Standards.....	2	60	30.00	18	9.00	78	39.00	40.75
Bureau of Fisheries.....	20	581	29.05	132	6.60	713	35.65	35.41
Bureau of Lighthouses.....	3	90	30.00	60	20.00	150	50.00	46.00
Coast and Geodetic Survey.....	13	382	29.38	140	10.77	522	40.15	37.00
Bureau of Navigation.....	5	148	29.60	71	14.20	219	43.80	41.30
Steamboat-Inspection Service.....								
Total and average.....	356	10,476	29.43	3,709½	10.42	14,185½	39.85	38.63

## TOTAL.

Office of the Secretary.....	144	3,932	27.31	1,076	7.47	5,008	34.78	32.94
Bureau of the Census.....	540	15,926	29.49	4,891½	9.06	20,817½	38.55	37.96
Bureau of Foreign and Domestic Commerce.....	102	2,942	28.84	723½	7.09	3,665½	35.93	34.65
Bureau of Standards.....	269	7,266	27.01	1,176½	4.37	8,442½	31.38	32.04
Bureau of Fisheries.....	71	1,817	25.59	370½	5.22	2,187½	30.81	31.78
Bureau of Lighthouses.....	34	1,008	29.65	252	7.41	1,260	37.06	37.61
Coast and Geodetic Survey.....	178	5,014	28.17	1,091	6.13	6,105	34.30	33.42
Bureau of Navigation.....	24	687	28.63	132	5.60	819	34.13	35.46
Steamboat-Inspection Service.....	9	240	26.66	25	2.78	265	29.44	28.81
Total and average.....	1,371	38,832	28.32	9,738	7.10	48,570	35.43	35.09

<sup>a</sup> In the count of the annual leave all periods of one-half day and over were counted as a full day; periods of less than one-half day were omitted.

The following statement, based on the percentages of the foregoing table, shows the relative standing of the bureaus for the calendar years 1916 and 1915 with respect to the lowest average amount of leave used:

Bureau.	Annual leave.		Sick leave.		Total.	
	1916	1915	1916	1915	1916	1915
Office of the Secretary.....	4	3	8	3	6	4
Bureau of the Census.....	8	8	9	9	9	9
Bureau of Foreign and Domestic Commerce.....	7	4	6	6	7	6
Bureau of Standards.....	3	2	2	2	3	3
Bureau of Fisheries.....	1	1	3	5	2	2
Bureau of Lighthouses.....	9	9	7	8	8	8
Coast and Geodetic Survey.....	5	6	5	4	5	5
Bureau of Navigation.....	6	7	4	7	4	7
Steamboat-Inspection Service.....	2	5	1	1	1	1

It will be noted that the Bureau of Fisheries retains the position held by it in 1915 as having the lowest average of annual leave per employee for the year 1916, and that the Steamboat-Inspection Service holds, for the third consecutive year, the lowest average of sick leave and of annual and sick leave combined.

Another table prepared in this Division indicates that less than 67 per cent of the employees considered (1,371) took all of their annual leave (30 days), that 5 per cent took all of their sick leave (30 days), and that 29 per cent took no sick leave. Three employees were reported as taking no annual leave during the year.

In accordance with the usual practice of the Department, as provided by the leave regulations, an examination was made in February last of the leave record of all employees for the past three years. A list was prepared showing the names of those employees who took all or practically all of their annual and sick leave (55 days or more) during the calendar years 1916, 1915, and 1914. This list included the names of 23 employees in 5 bureaus, an increase of 4 names over the last preceding list (calendar years 1915, 1914, and 1913). The attention of the heads of the bureaus concerned was called to the matter, and after personal consultation and correspondence with them steps were taken which, it is believed, will tend to reduce the large amount of leave taken by such employees.

Under date of January 27, 1917, the Department authorized the granting to the officers and clerks of the Steamboat-Inspection Service stationed in Hawaii and Alaska such an amount of annual leave in excess of that authorized by regulation as may be necessary in traveling to and from a mainland port of the United States, provided that travel between the station and the United States shall be by the shortest and most direct route usually followed.

The Department has adopted the following rule beginning with the present calendar year:

Employees who are compelled to take sick leave and have to their credit at the end of a calendar year, or upon separation from the service during the year, unused annual leave may, upon application, have the utilized sick leave, or any part thereof, charged to the annual leave remaining to their credit.

It has been the practice of the Department to permit the closing of offices in the field upon certain occasions, such as State holidays and days declared holidays by special order. The following authorizations were granted during the past fiscal year:

Date.	Occasion.	Offices affected.
Sept. 42, 1916.....	State holiday (Maryland), commemorating the battle of North Point, on which day "The Star-Spangled Banner" was written by Francis Scott Key.	Lighthouse Service, Baltimore, Md.
Nov. 7, 1916.....	State holiday (Maryland), "Election Day".	Do.
Feb. 20, 1917.....	State holiday (Louisiana), "Mardi Gras".	Lighthouse Service, New Orleans, La.
Apr. 6, 1917.....	State holiday (Maryland), "Good Friday".	Lighthouse Service, Baltimore, Md.
Apr. 19, 1917.....	State holiday (Maine), "Patriots' Day".	Lighthouse Service, Portland, Me.

On February 10, 1917, the Department issued authority to the district offices of the Bureau of Foreign and Domestic Commerce to close on days that are legal holidays in the cities where they are located, provided that such could be done without detriment to the public business.

## OFFICIAL BONDS.

The following table shows, as of June 30, 1917, the character, number, and penalty of bonds of officers of this Department required by law or regulation and the number of each kind given during the fiscal year ending on that date:

Bonded as—	Total number bonded.	Number bonded during fiscal year.	Aggregate penalty.	Statute or regulation requiring bond.
Disbursing clerk, Department of Commerce. <sup>a</sup>	1	.....	\$50,000	Sec. 176, R. S.
Special disbursing agent.....	68	43	620,000	Sec. 3614, R. S.
Chief of party, Coast and Geodetic Survey.	106	53	392,000	Sundry civil appropriation act, approved June 12, 1917, and prior years.
Shipping commissioner, Bureau of Navigation.	13	5	65,000	Sec. 4502, R. S., as amended by the act of Apr. 26, 1906 (34 Stat., 137).
Assistant in charge of office, Coast and Geodetic Survey.	1	.....	2,000	Par. 370, Regulations and Instructions for the Government of the Coast and Geodetic Survey, effective Jan. 1, 1913.
Total.....	189	101	1,138,000	

<sup>a</sup> The bond of the disbursing clerk of the Department is subject to the approval of the Secretary of the Treasury, and all records pertaining thereto are maintained by the Treasury Department.

<sup>b</sup> Includes 44 bonds given for the purpose of renewal or change in amount of penalty.

## COMPILATION OF DATA RELATING TO THE PERSONNEL.

The Division is frequently called upon to compile statistics relating to the personnel. Some idea of the varied character of the data furnished may be gathered from the following brief description of some of the statements prepared during the past fiscal year:

1. Positions under the jurisdiction of the Department in Porto Rico and Hawaii.
2. Names of employees of the Department in the District of Columbia appointed from Indiana, Kentucky, and Louisiana.
3. List of vacancies occurring by reason of employees called out with militia in connection with the operations on the Mexican Border.
4. Positions and salaries under the jurisdiction of the Department in New York City not subject to competitive civil-service examination.
5. Number of employees of the Department in the District of Columbia; the percentage of clerks who utilize sick leave, based on the statistics for the years 1914 and 1915; the annual duration of sick leave per employee for the years 1912 to 1915, inclusive; and the proportion of employees who utilized the maximum amount of 30 days of sick leave for the years 1914 and 1915.
6. Number and salaries of engineers and chemists in the employ of the Department.
7. Data in re appointments made in the Department "without regard to civil-service law" during the present and preceding administrations, and number of administrative officers appointed under preceding administrations and retained or separated.
8. Divisions and bureaus under the Department comparable to bureaus in the Panama Canal service.

9. Number and salaries of employees of the Department engaged upon medical work.

10. Schedule of separations of all employees, with certain exceptions, who have left the service during the five years ended June 30, 1917, in connection with the preparation of estimates of the probable cost of retirement of civil employees of the United States.

11. The total and average amount of annual and sick leave, stated separately and together, taken by employees of the Department in the District of Columbia, arranged by bureaus and according to sex, during 1916.

12. The number of employees of the Department in the District of Columbia who took (a) 30 days of annual leave, (b) no annual leave, (c) 30 days of sick leave, (d) no sick leave, (e) 30 days each of annual and sick leave, (f) no annual or sick leave during the calendar year 1916.

13. Relative positions of bureaus of the Department for 1916 and 1915 with regard to the use of the leave privileges.

14. Names, designations, and salaries of employees of the Department paid from the appropriation "Investigating cost of production, Department of Commerce," and change in their status since October 22, 1913.

15. Members of the visiting committee, Bureau of Standards, of the Department, from time of organization.

16. The field service of the Department, by States and by bureaus.

17. Number of aliens in the employ of the Department and number who have taken out first naturalization papers.

18. Names and salaries of women employees of Department receiving \$1,400 and upward and their special qualifications.

#### DECISIONS OF THE COMPTROLLER OF THE TREASURY.

The Comptroller of the Treasury rendered the following decisions relating to the personnel of the Department during the fiscal year:

*July 7, 1916.*—That the Bureau of Standards may contract for the furnishing of day labor for certain classes of construction work and pay for the same from appropriations which do not specifically authorize the employment of personal services.

*August 7, 1916.*—That the appointment of a gardener in the Bureau of Standards to be paid from an appropriation not providing for personal services is prohibited by the act of 1882.

*August 16, 1916.*—That the Bureau of the Census may collect certain statistics relating to city cartage under the act of February 14, 1903.

*September 26, 1916.*—That the unexpended balance of the appropriation for the cost of production division of the Bureau of Foreign and Domestic Commerce, after the transfer of that division to the United States Tariff Commission, is to be carried to the surplus fund of the Treasury.

*October 21, 1916.*—That topographic and hydrographic draftsmen in the Coast and Geodetic Survey may be detailed for temporary duty in the field, but their traveling expenses, while engaged on such special duty, are not payable from the appropriation for field service of the survey. A per diem allowance in lieu of subsistence, however, may be paid to such draftsmen from the appropriation last mentioned.

*December 22, 1916.*—That lump-sum appropriations of the Coast and Geodetic Survey are not available for the payment of \$1 per day to certain employees of the Lighthouse Service engaged, outside of their regular duties, in the performance of work for the Coast and Geodetic Survey.

*April 2, 1917.*—That the Bureau of the Census may collect certain statistics relating to marriage and divorce under act of March 3, 1917.

*April 7, 1917.*—That certain routine cement-testing work heretofore conducted by the Reclamation Service of the Interior Department, together with certain employees and equipment belonging to that service, may be transferred to the Bureau of Standards.

#### SUPERANNUATION AND RETIREMENT.

In spite of the fact that the Government is by far the largest employer of labor of any institution in this country, it is so ultra conservative in its treatment of its employees that its policies might, in comparison with smaller business concerns, be considered antiquated and obsolete. Tenure of office based on merit is now accepted among efficiency experts as the foundation of successful work. Accepting tenure of office as an established practice, the question of providing for the worn-out employee presents itself as a concomitant. Forty years of civil-service policy has burdened the service with aged and, more or less, inefficient employees, who have struggled hard against the unequal race between the advancing cost of living and a rate of compensation which advanced little, if any, during that period. The result is that, being able to make but little preparation for compulsory idleness in the closing years of life, they refuse to acknowledge themselves as worn out, and struggle, against nature, to keep their names on the Government pay roll. Nor can we blame the higher officials, who, in personal touch with these inutile employees, perceiving the well-meant struggles and knowing the circumstances refrain from taking the action which would cut off their only means of existence, though cognizant of the fact that their retention is detrimental to the efficiency of the service. Among large business corporations it has long been acknowledged that provision for superannuated employees justifies itself by every reason that makes for efficiency and economy. Stagnation among the old employees produces a like condition among those younger and lower in the scale of employment. Some of the latter have foresight and self-confidence enough to leave the service as soon as they have acquired high value, thus utilizing the experience they have gained at the Government's expense for the benefit of concerns that offer better and more equitable inducements; others, lacking those qualities, remain, many of them to swell the ranks of disheartened and indifferent employees who, seeing the chances for advancement barred, become satisfied with giving a modicum of service and later recruit the ranks of the inefficient.

A pension system is the acknowledged remedy for this condition. It has been demonstrated that the expense involved would be more than recovered by the gain in more efficient effort put forth by the younger employees, who would appreciate the incentive brought within their horizon in the form of greater opportunity for advancement by the possibility of transferring two inefficient to the pension roll and substituting therefor one earnest ambitious employee. Having seen demonstrations of the fact that equitable concessions to the worker have in the end proven a profitable business investment, the opinion of the public is becoming more and more favorable to the movement toward retirement pensions. Every step taken by Congress with this aim in view has been received with decreasing opposition.

The abnormal conditions of to-day, requiring large additions to the roll of civil-service workers, who are being secured with increasing difficulty, emphasizes the necessity of making the Government service more attractive. The action of hundreds of well-qualified civil-service eligibles in refusing appointment, on the ground of preferring the opportunities presented by outside service, has accentuated the necessity of a more liberal policy on the part of the Government toward its employees.

Closely allied to the question of retirement pensions is that of disability compensation, which has made rapid strides in recent years. Not long since regarded as an academic question, later considered as a fad of a few theorists, still later accepted for a limited number of branches of the service, it has at last become a matter of general benefit through the passage by Congress of the act approved September 7, 1916, to provide compensation for employees of the United States suffering injuries incurred while in the performance of their duties.

#### SALARIES.

The Department has found it necessary, owing to the high cost of living and the present conditions in the commercial and industrial world, to offer higher entrance salaries for positions of clerk, stenographer, and typewriter, and those of a scientific and mechanical nature, in cases where conditions rendered such action advisable and it could properly do so. It frequently occurs that an eligible who when he made application for examination stated his readiness to accept a salary of \$720 per annum now answers an offer of such a position with a statement that he can not consider less than \$1,200. Formerly eligibles were plentiful at \$720 to \$900 per annum; the minimum now appears to be rapidly becoming \$1,000.

The increased rates of pay given in the merchant marine combined with the advancing cost of living rendered it very difficult to obtain and retain in the service the personnel of the vessels of the Department, and it was found necessary from time to time during the last fiscal year to make such increases of compensation in the marine service as the appropriations made for the purpose would permit. Even with this encouragement and that afforded by the general increases made July 1, 1917, the pay of the naval personnel is yet much lower, generally, than is offered for like duties in the merchant marine.

While the 5 and 10 per cent increase in the compensation of employees earning \$1,800 or less per annum is highly appreciated by those benefited, it can only be looked upon as a partial, as it is a temporary, attempt to relieve the pressure resulting from the high cost of living. Eliminating from consideration the question of the right to earn a decent living in return for labor, there is a phase of the question which should be given due weight by those who have to study the Government service from an economical point of view, namely, that of the constant and costly drain upon the skilled workers of this service caused by the withdrawal of its best material for outside service, which offers better inducements. A capable Government clerk can not be made on short order, and the securing and



training of new material to replace those seduced into other channels is a constant source of expense financially and a loss in efficiency.

#### DEPARTMENT'S POLICY WITH RESPECT TO THE APPOINTMENT OF WOMEN.

It is the policy of the Department to afford women seeking Government employment as many opportunities as circumstances will permit to enter its service, particularly in positions of a clerical nature; and when selected they are appointed upon the same requisites and conditions and with the same compensation as are prescribed for men. In view of present conditions in the industrial world, great difficulty has been experienced in obtaining properly qualified male eligibles, and an unusual opportunity has, therefore, arisen for the appointment of women who are able to pass the required civil-service examinations. The Department, in fact, has requested its various bureau chiefs, until further notice, to prefer women for appointment to clerical and other positions, such as stenographer, typewriter, and the like, for which they are qualified. All such appointments are, however, made in accordance with the provisions of the civil-service act and rules. During the past four months women were given 140 out of a total of 217 probational appointments in clerical positions.

#### CIVIL-SERVICE METHODS.

The demands made by the Department upon the Civil Service Commission for eligibles have been greater during the present fiscal year than for any like period before. This has been especially true with respect to clerical positions. Notwithstanding the fact that the Civil Service Commission has been holding examinations weekly at Washington and throughout the country for stenographer and typewriter positions, and the certainty of eligibles receiving appointment, the Commission has been unable at times to furnish eligibles for these positions. It would seem that if the Government is to obtain the class of eligibles desired and retain them in its service it will be necessary to materially increase the pay of the \$720 and \$900 clerical positions, in any event until conditions again become normal. For statutory positions, however, this can be done only by congressional authority.

In many instances it has been imperative that eligibles be secured and appointments made at the earliest possible moment. The Commission has in such cases furnished the Department with the names of eligibles, if available, by telephone, thus reducing the delay to the minimum. There have been cases, however, where there was some delay on the part of the Commission in taking action on cases presented by the Department. It is believed that in such cases the delay was unavoidable, taking into consideration the limited force of the Commission and the abnormally large volume of business placed upon it by war conditions. The officials of the Commission have cooperated with the appointing officers of the Department in a manner to be commended, and have at all times shown a desire to

assist the Department in every way possible to expedite its appointment work.

Civil-service procedure has been changed in order to more nearly meet the changed conditions due to the war and other causes. Among such changes may be mentioned the following as appertaining to the personnel of the Department:

(a) The Commission may in reinstatements and transfers, when not inconsistent with existing laws, disregard the period during which an employee was in the military service of the United States under the President's call of June 18, 1916.

(b) The Commission may, because of a public exigency, authorize the immediate filling of a position for which there is no suitable eligible by the appointment of a person shown to be qualified by such noncompetitive tests of fitness as the Commission may prescribe.

(c) Permitting the reinstatement, within three years from the date of separation from the competitive service, of persons resigning from scientific, professional, or technical positions in the competitive service to enter the public service of a State, county, municipality, or foreign government in a similar capacity.

(d) Authorizing the employment of students of technical or scientific schools as student assistants in the Bureau of Standards, at a salary of not to exceed a rate of \$300 per annum.

#### EFFECT OF WAR SITUATION ON PERSONNEL.

The war situation has operated to increase the volume and variety of the business of the Appointment Division. Two bureaus of the Department, viz, Foreign and Domestic Commerce and Standards, have augmented their forces as the result of war conditions, and the appointment work incident thereto has steadily increased. The call for the immediate filling of new positions has been urgent, and by giving such cases precedence over other business, at the same time putting forth every effort to expedite action thereon, the Division has been able to dispose of all cases promptly without neglecting its usual routine affairs.

The following table, arranged under date of August 31, 1917, shows the number of persons who have been appointed under appropriations for "National security and defense," Department of Commerce, by bureaus:

Bureau.	Service.	In District of Columbia.	In field.
Standards.....	Gauge standardization, etc.....	78	.....
Do.....	Military research.....	172	..... 3
Do.....	Equipping chemical laboratory.....	24	.....
Foreign and Domestic Commerce.....	Exports license work.....	251	..... 23

• Transferred to the Exports Administrative Board Aug. 27, 1917.

Heretofore no restrictions have been imposed on employees taking examination for other branches of the service, but now examination or certification may be prohibited under the terms of the Executive order of April 2, 1917, which states that—

In view of the present emergency conditions and until further notice, the Civil Service Commission is directed to refuse examination to any person who is, or who has been within three months of the date of the examination, employed in the Government service, or to certify any such person who is on the eligible

register of the commission, unless such person submits the written assent of the department or office in which he is or has been employed to his taking such examination or to his being so certified. Such assent shall be based solely upon the finding, after due consideration by such department or office, that the person can render better service for the Government in the place for which the examination is held.

This order is issued solely because of the present international situation and will be withdrawn when the emergency is past.

The Department has adopted a liberal attitude toward employees desiring to take examinations, and in only one instance has assent been denied, the chief of the bureau having stated that the employee's services were indispensable in the section to which he had been recently transferred with the understanding that he would take up that branch of the work permanently.

Special legislation and war measures which have to do with the personnel of certain bureaus of the Department are listed below, by bureaus.

*Coast and Geodetic Survey.*—Section 16 of the act of May 22, 1917, authorizes the President, whenever in his judgment a national emergency exists, to transfer to the service and jurisdiction of the War Department or of the Navy Department such vessels, equipment, stations, and personnel of the Coast and Geodetic Survey as he may deem to the best interest of the country. It provides also that "any of the personnel of the Coast and Geodetic Survey who may be transferred as herein provided shall, while under the jurisdiction of the War Department or the Navy Department, have proper military status and shall be subject to the laws, regulations, and orders for the government of the Army or Navy, as the case may be, in so far as the same may be applicable to persons whose retention permanently in the military service of the United States is not contemplated by law."

*Bureau of Standards.*—The act approved June 15, 1917, making appropriations to supply urgent deficiencies in appropriations for the military and naval establishments on account of war expenses, provides, among other things, for cooperation by the Bureau of Standards with the War and Navy Departments by providing for "the scientific assistance necessary in the development of instruments, devices, and materials, and the standardization and testing of supplies," completion of chemical laboratory, including personal services in the District of Columbia, and for cooperation among the three services above mentioned and the Council of National Defense, including the employment of personal services, "for standardization and testing of the standard gauges, screw threads, and standards required in manufacturing throughout the United States, and to calibrate and test such standard gauges, screw threads, and standards."

*Bureau of Lighthouses.*—By Executive order of April 11, 1917, issued in accordance with the authority vested in the President by the "Act making appropriations for the Naval Service for the fiscal year ending June 30, 1917, and for other purposes," approved August 29, 1916, certain lighthouse vessels and light stations, including the equipment and personnel thereof, were transferred to the service and jurisdiction of the War Department and of the Navy Department.

*Bureau of Foreign and Domestic Commerce.*—The administration of the export-control portion of the act of Congress approved June 15, 1917, entitled "An Act to punish acts of interference with the

foreign relations, the neutrality and the foreign commerce of the United States, to punish espionage, and better to enforce the criminal laws of the United States, and for other purposes," was placed under the jurisdiction of the Secretary of Commerce, and the force was organized and work commenced through the medium of the Bureau of Foreign and Domestic Commerce. On August 27, 1917, however, the work was transferred with the personnel to the Exports Administrative Board.

Respectfully,

CLIFFORD HASTINGS,

*Chief of Appointment Division.*

To Hon. WILLIAM C. REDFIELD,

*Secretary of Commerce.*



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**REPORT**  
**OF THE**  
**CHIEF, DIVISION OF PUBLICATIONS**

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1033



# REPORT

## OF THE

### CHIEF, DIVISION OF PUBLICATIONS.

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DEPARTMENT OF COMMERCE,  
DIVISION OF PUBLICATIONS,  
*Washington, September 1, 1917.*

SIR: The following report concerning the work of the Division of Publications during the fiscal year ended June 30, 1917, is respectfully submitted.

#### DUTIES OF THE DIVISION.

The Division of Publications is charged with an economical expenditure of the printing and binding allotment of the Department. This responsibility involves the conduct of the business which the Department transacts with the Government Printing Office, and general supervision over all printing (including editing and preparing copy), illustrating, and binding for the Department, and keeping records of expenditures and incurred liabilities. The Division has in charge also the distribution of publications; the maintenance of mailing lists; the operation of duplicating, addressing, folding, sealing, and mailing equipments; the advertising done by the Department; and the correspondence which these duties entail.

The pages following epitomize the activities of the Division along these lines.

#### ALLOTMENT AND EXPENDITURES.

The act of July 1, 1916, making appropriations for the sundry civil expenses of the Government for the fiscal year ending June 30, 1917, and for other purposes, allotted to the Department \$400,000 for printing and binding during the fiscal year 1917. Of this sum \$382,602.76 was expended, leaving an unused balance on June 30 of \$17,397.24. The decrease in expenditures in 1917 compared with 1916 was \$7,235.52 (or 1.86 per cent), the allotment in 1916 being \$390,000 and the expenditures \$389,838.28.

The estimated cost of unbilled and uncompleted work of the Department at the Government Printing Office on July 1, 1917, and chargeable against the allotment for 1918, was \$69,756.48, while such work at the Government Printing Office on the same date in 1916 actually cost \$68,771.41.

During the fiscal year 1917 the Department issued on the Public Printer 2,722 requisitions for printing and binding, compared with 3,709 during the preceding fiscal year, a decrease of 987. The marked decrease was due largely to the printing for the Bureau of



the Census during the fiscal year 1916 of nearly 800 summaries, giving advance information regarding the condition of manufacturing industries in many cities and States, developed during the taking of the census of manufactures of 1914.

Of the requisitions issued in 1917 there remained at the close of the fiscal year 416 on which deliveries of completed work had not been made, compared with 379 in 1916, 436 in 1915, 355 in 1914, and 344 in 1913.

#### COST OF PRINTING AND BINDING, BY BUREAUS.

The following table shows the cost of printing and binding for each of the bureaus, offices, and services of the Department during the fiscal years 1916 and 1917, together with the increase or decrease for each bureau, office, and service, and the estimated cost of the work on hand but not completed June 30, 1917:

Bureau, office, or service.	Cost of work delivered.		Increase (+) or decrease (—).		Estimated cost of work not completed June 30, 1917.
	1916	1917	Cost.	Per cent.	
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, Chief Clerk, and Division of Publications).....	\$16,581.71	\$15,432.08	—\$1,149.63	— 6.93	\$1,999.32
Appointment Division.....	236.86	373.00	+ 136.14	+57.48	198.00
Disbursing Office.....	747.23	606.21	— 51.02	— 6.83	65.00
Division of Supplies.....	601.39	184.85	— 416.54	—69.26	5.31
Bureau of the Census.....	84,766.94	115,971.35	+31,204.41	+36.81	33,593.86
Coast and Geodetic Survey.....	28,795.27	28,685.67	— 109.60	— .38	10,950.41
Bureau of Fisheries.....	12,460.20	16,432.46	+ 3,972.26	+31.88	2,114.47
Bureau of Foreign and Domestic Commerce.....	131,262.35	121,529.73	— 9,732.62	— 7.41	9,677.06
Bureau of Lighthouses.....	21,080.27	18,569.17	— 2,511.10	—11.91	624.19
Lighthouse Service.....	7,208.17	4,771.61	— 2,436.56	—33.80	1,950.74
Bureau of Navigation.....	16,928.60	14,740.06	— 2,188.44	—12.93	37.94
Shipping Service.....	4,478.48	2,491.36	— 1,987.12	—44.37	541.19
Radio Service.....	894.76	589.98	— 304.78	—34.06	9.64
Bureau of Standards.....	35,824.68	23,649.34	—12,175.34	—33.99	4,313.98
Office of the Supervising Inspector General, Steamboat-Inspection Service.....	2,335.03	1,009.08	— 1,325.95	—56.79	436.08
Steamboat-Inspection Service.....	14,466.86	10,701.05	— 3,765.81	—26.03	535.46
Customs Service.....	11,169.68	6,775.76	— 4,393.92	—39.34	1,684.24
<b>Total.....</b>	<b>389,838.28</b>	<b>382,602.76</b>	<b>— 7,235.52</b>	<b>— 1.86</b>	<b>69,756.48</b>

#### SUMMARY OF EXPENDITURES, 1907-1917.

The following statement gives for each of the fiscal years 1907 to 1917 the amount available to the Department for printing and binding, the amount expended, the unused balance on June 30, and the cost of work not completed at the close of the year. Figures prior to 1913 include expenditures for bureaus and services transferred to the Department of Labor by the act of March 4, 1913, but do not include those for the Bureau of the Census, which was formerly provided for by separate allotments or appropriations. Expenditures for the Bureau of Corporations also are included in years prior to 1916.

Fiscal year.	Allotment.	Expenditures.	Unused balance.	Cost of work not completed June 30.
1907.....	\$375,000.00	\$332,185.05	\$42,814.95	\$34,749.24
1908.....	375,000.00	342,962.36	32,037.64	47,055.59
1909.....	375,000.00	374,939.91	60.09	29,139.26
1910.....	<sup>a</sup> 375,337.43	<sup>a</sup> 361,530.43	14,807.00	42,535.93
1911.....	<sup>b</sup> 381,500.00	<sup>b</sup> 375,575.02	5,924.98	46,173.12
1912.....	375,000.00	374,995.64	4.36	43,956.76
1913.....	<sup>c</sup> 329,978.06	<sup>c</sup> 329,974.92	3.14	36,686.50
1914.....	441,000.00	410,700.77	30,299.23	49,827.74
1915.....	400,000.00	399,999.47	50.53	55,993.72
1916.....	390,000.00	389,838.28	161.72	68,771.41
1917.....	400,000.00	382,602.76	17,397.24	<sup>d</sup> 69,756.48

<sup>a</sup> Includes \$1,337.43 expended for supplies furnished the Bureau of the Census, for which the Department's allotment was reimbursed.

<sup>b</sup> Includes a special appropriation of \$6,500 for the printing of the World Trade Directory. The entire sum was expended for the publication.

<sup>c</sup> The Department's allotment was reimbursed for printing and binding furnished the Bureau of Navigation for the Radio Service, costing \$1,716.58, from the appropriation "Enforcement of wireless communication laws, 1913"; also for work furnished the Bureau of the Census, costing \$5,011.43, of which \$383.29 was reimbursed from the appropriation "Tobacco statistics, Bureau of the Census, 1913," and \$4,628.19 from the appropriation "Cotton statistics, Bureau of the Census, 1913."

<sup>d</sup> Estimated.

#### QUANTITY AND COST OF PRINTING AND BINDING, BY CLASSES.

The following statement shows the amount and cost of each class of work called for by requisitions on the Public Printer during the fiscal year 1917, and affords a comparison with the amount and cost of these classes during the preceding fiscal year:

Class.	1916	1917	Increase (+) or decrease (-).	
	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Per cent.</i>
Blank forms.....	15,859,014	17,298,211	+1,439,197	+ 9.07
Reports, pamphlets, etc.....	4,447,984	4,016,515	- 431,469	- 9.70
Letterheads.....	3,192,000	3,562,000	+ 370,000	+11.59
Envelopes.....	136,675	50,000	- 86,675	-63.42
Circulars, summaries, and notices.....	2,900,900	384,475	-2,516,425	-86.75
Index cards.....	1,133,500	1,837,400	+ 703,900	+62.10
Guide cards and folders.....	305,000	88,500	- 216,500	-70.98
Memorandum sheets.....	3,355,500	1,686,000	-1,669,500	-52.73
Blank books.....	19,955	27,191	+ 7,236	+36.26
Miscellaneous books (binding).....	5,896	2,866	- 3,032	-51.41
	<i>Cost.</i>	<i>Cost.</i>	<i>Cost.</i>	<i>Per cent.</i>
Blank forms.....	\$38,128.35	\$33,246.00	-\$4,882.35	-12.81
Reports, pamphlets, etc.....	309,652.01	\$20,981.44	+11,329.43	+ 3.66
Letterheads.....	4,441.32	4,971.42	+ 530.10	+11.94
Envelopes.....	404.38	210.71	- 193.67	-47.89
Circulars, summaries, and notices.....	8,194.77	2,118.95	- 6,075.82	-74.14
Index cards.....	9,917.97	1,268.75	+ 350.78	+3.52
Guide cards and folders.....	1,264.60	857.81	- 406.79	-32.17
Memorandum sheets.....	2,454.04	407.24	- 2,046.80	-83.41
Blank books.....	14,686.95	8,190.64	- 6,496.31	-44.23
Miscellaneous books (binding).....	9,179.56	9,513.53	+ 333.97	+ 3.64
Miscellaneous.....	514.24	836.27	+ 322.03	+62.62
Total.....	389,838.28	382,602.76	- 7,235.52	- 1.86

The following table gives the cost of work ordered from the Public Printer during the fiscal years 1916 and 1917, by classes and by bureaus, offices, and services:

Bureau, office, or service.	Blank forms.		Reports, pamphlets, etc.		Letterheads.	
	1916	1917	1916	1917	1916	1917
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, Chief Clerk, and Division of Publications).....	\$1,157.05	\$951.39	\$6,773.51	\$7,480.87	\$536.60	\$1,014.79
Appointment Division.....	155.31	204.46	67.92	74.36	4.83	5.71
Disbursing Office.....	650.33	647.75	6.86	.....	10.72	16.48
Division of Supplies.....	226.14	173.27	.....	.....	.....	11.58
Bureau of the Census.....	10,507.28	12,113.09	65,367.46	97,473.81	638.06	928.04
Coast and Geodetic Survey.....	2,067.44	1,895.29	23,849.25	24,932.88	505.72	388.96
Bureau of Fisheries.....	1,008.99	1,863.76	10,233.91	13,675.43	109.06	133.41
Bureau of Foreign and Domestic Commerce.....	3,271.92	2,389.04	123,384.51	116,300.84	1,112.26	677.96
Bureau of Lighthouses.....	93.75	39.23	20,718.02	18,159.54	51.91	42.26
Lighthouse Service.....	3,967.47	2,844.84	843.92	150.20	486.47	676.47
Bureau of Navigation.....	233.45	293.19	16,574.91	14,303.72	66.53	52.62
Shipping Service.....	2,818.64	1,466.86	.....	.....	44.45	89.97
Radio Service.....	598.10	326.90	.....	.....	85.94	70.29
Bureau of Standards.....	1,662.88	1,826.08	30,671.92	19,658.91	278.95	442.77
Office of Supervising Inspector General, Steamboat Inspection Service.....	24.46	102.45	2,132.04	820.62	52.72	52.16
Steamboat Inspection Service.....	4,137.85	2,335.25	8,941.76	7,970.86	376.80	394.94
Customs Service.....	5,547.29	3,783.15	86.02	.....	.....	.....
<b>Total.....</b>	<b>38,128.35</b>	<b>33,246.00</b>	<b>300,662.01</b>	<b>320,961.44</b>	<b>4,441.32</b>	<b>4,971.42</b>

Bureau, office, or service.	Envelopes.		Circulars, summaries, and notices.		Index cards.		Guide cards and folders.	
	1916	1917	1916	1917	1916	1917	1916	1917
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, Chief Clerk, and Division of Publications).....	\$93.60	\$128.44	\$698.42	\$342.06	\$570.26	\$987.67	\$809.79	\$677.74
Appointment Division.....	.....	.....	.....	.....	.....	.....	8.80	13.44
Disbursing Office.....	.....	.....	.....	.....	1.90	.....	5.80	.....
Division of Supplies.....	.....	.....	.....	.....	.....	.....	.....	.....
Bureau of the Census.....	42.92	.....	6,220.40	648.01	2.12	9.38	6.21	.....
Coast and Geodetic Survey.....	52.36	19.50	2.73	47.15	2.73	14.09	.....	8.88
Bureau of Fisheries.....	10.13	.....	250.82	422.87	23.16	12.18	9.26	.....
Bureau of Foreign and Domestic Commerce.....	197.78	55.77	839.33	.....	8.84	19.39	152.99	27.61
Bureau of Lighthouses.....	2.49	.....	90.29	158.83	.....	.....	19.00	23.54
Lighthouse Service.....	.....	.....	.....	.....	24.27	.....	.....	3.96
Bureau of Navigation.....	.....	7.00	.....	.....	.....	.....	26.26	26.78
Shipping Service.....	.....	.....	.....	.....	.....	.....	.....	4.63
Radio Service.....	.....	.....	.....	.....	.....	.....	.....	21.19
Bureau of Standards.....	.....	.....	.....	.....	277.38	226.04	217.67	25.66
Office of Supervising Inspector General, Steamboat Inspection Service.....	5.10	.....	102.88	.....	.....	.....	8.91	22.63
Steamboat Inspection Service.....	.....	.....	.....	.....	.....	.....	.....	.....
Customs Service.....	.....	.....	.....	.....	7.31	.....	.....	.....
<b>Total.....</b>	<b>404.38</b>	<b>210.71</b>	<b>8,194.77</b>	<b>2,118.96</b>	<b>917.97</b>	<b>1,268.75</b>	<b>1,264.69</b>	<b>857.81</b>

Bureau, office, or service.	Memorandum sheets.		Blank books.		Miscellaneous books (binding).		Miscellaneous.	
	1916	1917	1916	1917	1916	1917	1916	1917
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, Chief Clerk, and Division of Publications).....	\$2,083.93	\$346.50	\$2,202.02	\$1,570.03	\$1,254.81	\$914.59	\$301.72	\$538.00
Appointment Division.....								75.08
Disbursing Office.....			64.26	27.00	7.36	4.98		
Division of Supplies.....	370.11				5.14			
Bureau of the Census.....		56.73	36.46	291.41	1,827.63	4,228.61	118.40	222.24
Coast and Geodetic Survey.....			1,650.69	631.25	664.35	747.72		
Bureau of Fisheries.....			152.23	327.28	662.64	5.53		
Bureau of Foreign and Domestic Commerce.....		4.01		383.26	2,943.70	1,671.86	61.12	
Bureau of Lighthouses.....			31.57	16.42	92.24	129.33		
Lighthouse Service.....			1,887.04	949.50		146.62		
Bureau of Navigation.....					27.05	54.75		
Shipping Service.....			1,358.35	752.18	257.04	207.93		
Radio Service.....			210.72	171.60				
Bureau of Standards.....			596.53	164.90	2,086.35	1,302.99	33.00	1.00
Office of Supervising Inspector General, Steamboat-Inspection Service.....				1.75	8.92	10.17		
Steamboat-Inspection Service.....			1,010.45					
Customs Service.....			5,486.63	2,904.06	42.33	88.55		
Total.....	2,454.04	407.24	14,686.95	8,190.64	9,179.56	9,513.53	514.24	836.27

## PUBLICATIONS ISSUED.

There is submitted on the following pages a list of publications issued by the Department during the last fiscal year, and the number of each distributed up to July 1, 1917. Some of the publications listed were received too late for general distribution before the end of the year. The list is confined to publications becoming available for distribution or use during the year, and includes congressional documents emanating from the Department and for the printing of which the Department's allotment for printing and binding usually was drawn upon, in accordance with the provisions of Public Resolution No. 13, approved March 30, 1906.

## PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF, FISCAL YEAR 1917.

[Unless otherwise stated, size of each publication is 5½ by 9½ inches.]

## OFFICE OF THE SECRETARY.

Title and description.	Re-ceived.	Dis-tributed.	Cost.
Annual report of Secretary, 1916. 261 p. 1 pl. 10 p. of pl. 1 diag. 4 text fig. ....	3,500	2,469	\$1,393.28
Same [press proofs; extracts from]. 65 l. ....	1,850	1,850	103.44
Reports of Department, 1916. Report of Secretary and reports of bureaus [consolidated]. [Printed also as H. doc. 1482, 64th Cong. 2d sess.] 1,064 p. 1 pl. 10 p. of pl. 1 poster, 1 diag. 4 text fig. ....	500	288	1,522.99
Annual report of Chief, Appointment Division, 1916. 24 p. ....	350	342	74.36
Annual report of Chief, Division of Publications, 1916. 36 p. ....	400	332	221.71
List of publications of Department available for distribution. 14th edition. Oct. 2, 1916. 83 p. ....	3,000	3,000	349.33
Same [reprint]. ....	750	750	51.68
Same [reprint]. ....	1,000	1,000	54.50
Same. 15th edition. May 8, 1917. 77 p. ....	5,300	4,108	428.96
Monthly list of publications issued by Department [June, 1916-May, 1917, 12 numbers]. 43 p. ....	34,800	34,800	219.19

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## OFFICE OF THE SECRETARY—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Department circulars [all 8x10 1/2"]:			
77, 2d edition. Certificate as to available balance of appropriation to be forwarded by chiefs of bureaus with every contract submitted for approval. July 20, 1916. 1 p.	500	100	36.04
149, 3d edition. Contracts submitted for approval of Secretary of Commerce. Nov. 11, 1916. 1 p.	300	50	5.55
175, 2d edition. Regulations regarding printing and binding. July 31, 1916. 8 p.	1,300	200	43.58
184, 2d edition. Procedure in making selections from eligible lists of Civil Service Commission and in scrutinizing probationary periods of new appointees. July 20, 1916. 2 p.	500	100	11.09
204, 2d edition. Property accounting. Sept. 8, 1916. 9 p.	1,500	150	51.75
230, 2d edition—Bureau of Navigation. Rules to prevent collisions of vessels. June 8, 1917. 17 p.	30,000	1,000	618.51
236, 4th edition—Bureau of Navigation and Steamboat-Inspection Service. Regulation of motor boats. May 20, 1916. [Reprint.] 4 p.	50,000	45,000	127.76
240, 3d edition—Bureau of Navigation. Registry of foreign-built vessels. Sept. 21, 1914. [Reprint.] 3 p.	500	300	4.20
242, 2d edition. Oaths to expense accounts. July 20, 1916. 2 p.	500	250	9.52
246, 4th edition—Bureau of Fisheries, Alaska Fisheries Service. Regulations for protection of fur-bearing animals in Alaska. Feb. 1, 1916. [Reprint.] 3 p.	2,000	1,900	19.08
247—Bureau of Navigation. Rules and regulations to promote safety of life on navigable waters during regattas or marine parades. May 19, 1913. [Reprint.] 2 p.	1,000	500	2.39
258—Bureau of Navigation [modifies 120, July 21, 1906]. Allotments of seamen's wages. Aug. 10, 1915. [Reprint.] 2 p.	1,000	600	
261—Bureau of Navigation. Accidents sustained or caused by barges in tow. Aug. 12, 1915. [Reprint.] 1 p.	1,000	500	
262—Bureau of Navigation and Steamboat-Inspection Service. Hours of labor on shipboard. Aug. 12, 1915. [Reprint.] 1 p.	1,500	1,000	
263—Bureau of Navigation. Discharge of seamen in special cases [sec. 19, seamen's act of Mar. 4, 1915]. Aug. 25, 1915. [Reprint.] 1 p.	1,000	500	17.15
265—Bureau of Navigation. Language test under seamen's act. Sept. 18, 1915. [Reprint.] 1 p.	1,000	300	
266—Steamboat-Inspection Service. Scope of sec. 14, seamen's act [relating to life-saving regulations for steam vessels]. Sept. 24, 1915. [Reprint.] 1 p.	1,000	400	
270—Bureau of Navigation. Boarding of vessels. May 4, 1916. [Reprint.] 2 p.	15,000	8,000	21.52
272—Bureau of Navigation and Steamboat-Inspection Service. Executive order under sec. 2, ship-registry act of Aug. 1914. Sept. 1, 1916. 1 p.	2,000	2,000	7.06
Same [reprint].	1,000	100	2.58
273 [supersedes 255, 1st and 2d editions, Dec. 21, 1914, and Jan. 10, 1916]. Repeal of stamp tax upon guaranties, bonds, policies of insurance, deeds, powers of attorney, and certificates. Sept. 20, 1916. 1 p.	1,500	800	7.16
274—Steamboat-Inspection Service. Caution and admonition to those concerned in transportation of dangerous or inflammable articles. Nov. 21, 1916. 1 p.	10,000	9,400	19.09
Establishment of load-line regulations: Proceedings of conference held at office of Secretary, Sept. 27, 1916, before Hon. William C. Redfield. 54 p.	1,000	375	97.93
Advisory conference on subject of making passenger vessels more secure from destruction by fire, held in office of Secretary, May 3, 1916. 63 p.	1,000	415	128.64
Automatic sprinklers on vessels: Proceedings of conference held in Department, May 22, 1916. 34 p. 2 text fig.	1,000	425	92.04
Department of Commerce: Origin and organization. [Reprint.] 71 p. 6x7 1/2"	5,000	2,980	143.50
Letter from Secretary of Commerce relating to recommendation of Secretary of Treasury for appropriation required by Coast Guard to develop its telephone system of coastal communication. Feb. 20 (calendar day Feb. 22), 1917. [Printed as S. doc. 716, 64th Cong. 2d sess.] 3 p.	(a)	(a)	6.23
Letter from Secretary of Commerce requesting certain authority in matter of paying commutation of rations to officers and crews of vessels of Fisheries Service. July 25, 1916. [Printed as H. doc. 1295, 64th Cong. 1st sess.] 2 p.	(a)	(a)	4.22
Estimate of appropriation for aids to navigation, Gulf of Mexico. Aug. 15, 1916. [Printed as H. doc. 1328, 64th Cong. 1st sess.] 9 p.	(a)	(a)	24.38
Rules and regulations prescribed by Board of Supervising Inspectors, Steamboat-Inspection Service. Dec. 6, 1916. [Printed as H. doc. 1437, 64th Cong. 2d sess.] 644 p. 26 text fig.	(b)	(b)	14.74

<sup>a</sup> None printed for the Department.

<sup>b</sup> The Department edition was printed in four separate volumes, the data for which appear in this list under "Steamboat-Inspection Service."

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## OFFICE OF THE SECRETARY—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Petition from certain employees of Department requesting an increase in salaries of classified employees. Dec. 6, 1916. [Printed as H. doc. 1442, 64th Cong. 2d sess.] 3 p.	(e)	(e)	\$5.62
Letter from Secretary of Commerce calling attention to certain items in estimates of appropriations, Lighthouse Service, fiscal year 1918. Dec. 6, 1916. [Printed as H. doc. 1446, 64th Cong. 2d sess.] 6 p.	(e)	(e)	12.95
Detailed statements of disbursements by Department. Dec. 7, 1916. [Printed as H. doc. 1506, 64th Cong. 2d sess.] 105 p.	(e)	(e)	784.22
Accidents caused by barges in tow, Nov. 4, 1915, to June 30, 1916. Dec. 14, 1916. [Printed as H. doc. 1743, 64th Cong. 2d sess.] 7 p.	(e)	(e)	19.06
Letter from Secretary of Commerce transmitting communication from Commissioner of Lighthouses on subject of pay of junior clerks, Lighthouse Inspection Service. Dec. 14, 1916. [Printed as H. doc. 1745, 64th Cong. 2d sess.] 4 p.	(e)	(e)	7.73
Letter from Secretary of Commerce transmitting communication from Commissioner of Fisheries, with copy of letter from Aliston G. Adams, apprentice fish culturist at Boothbay Harbor (Me.) station of Bureau of Fisheries, in re increased compensation for Government employees. Dec. 14, 1916. [Printed as H. doc. 1750, 64th Cong. 2d sess.] 2 p.	(e)	(e)	4.47
Expenditures in Coast and Geodetic Survey, fiscal year 1916. Dec. 18, 1916. [Printed as H. doc. 1762, 64th Cong. 2d sess.] 15 p.	(e)	(e)	92.10
Claims of damages due to claimants by Commissioner of Lighthouses. Dec. 18, 1916. [Printed as H. doc. 1770, 64th Cong. 2d sess.] 2 p.	(e)	(e)	3.75
Estimate of appropriation for introducing new aquatic food supplies. Jan. 3, 1917. [Printed as H. doc. 1871, 64th Cong. 2d sess.] 2 p.	(e)	(e)	4.68
Estimate of additional appropriation for Bureau of Fisheries, fiscal year 1917. Jan. 3, 1917. [Printed as H. doc. 1872, 64th Cong. 2d sess.] 2 p.	(e)	(e)	4.68
Estimate of deficiencies in appropriations, Department of Commerce, fiscal year 1917. Jan. 3, 1917. [Printed as H. doc. 1876, 64th Cong. 2d sess.] 7 p.	(e)	(e)	25.54
Estimate of appropriation for repairing and overhauling Bureau of Fisheries steamer Fish Hawk. Jan. 8, 1917. [Printed as H. doc. 1894, 64th Cong. 2d sess.] 2 p.	(e)	(e)	4.47
Amendment of estimate of appropriations under head of "Miscellaneous expenses, Bureau of Fisheries," fiscal year 1918. Jan. 10, 1917. [Printed as H. doc. 1904, 64th Cong. 2d sess.] 2 p.	(e)	(e)	3.61
Petition requesting increase of salaries of officers of relief light vessel No. 58 and increase in subsistence allowance to officers and crew. Jan. 11, 1917. [Printed as H. doc. 1924, 64th Cong. 2d sess.] 2 p.	(e)	(e)	3.61
Damage claims against Coast and Geodetic Survey. Jan. 13, 1917. [Printed as H. doc. 1936, 64th Cong. 2d sess.] 7 p.	(e)	(e)	17.63
Petition requesting increase in compensation of local inspectors of Steamboat-Inspection Service at Cincinnati. Jan. 13, 1917. [Printed as H. doc. 1938, 64th Cong. 2d sess.] 2 p.	(e)	(e)	3.61
List of useless papers in Department. Jan. 23, 1917. [Printed as H. doc. 1974, 64th Cong. 2d sess.] 12 p.	(e)	(e)	32.12
Documents received and distributed by Department, fiscal year 1916. Jan. 30, 1917. [Printed as H. doc. 2002, 64th Cong. 2d sess.] 19 p.	(e)	(e)	154.18
Estimate of appropriation for printing charts, Coast and Geodetic Survey. Feb. 20, 1917. [Printed as H. doc. 2075, 64th Cong. 2d sess.] 2 p.	(e)	(e)	6.05
Estimate of appropriation for steamboat inspectors, Tampa, Fla. Feb. 27, 1917. [Printed as H. doc. 2097, 64th Cong. 2d sess.] 2 p.	(e)	(e)	4.47
Registry of seagoing vessels, letter from Secretary of Commerce transmitting, in response to Senate resolution of Mar. 15, 1917, report of all seagoing vessels for which application has been made for registry under laws of United States, and also vessels for which such application has been made [which] have been in fact granted registration, between Jan. 1, 1916, and Mar. 15, 1917, with full information relative to nationality of such vessels. Mar. 16, 1917. [Printed as S. doc. 4, 65th Cong. special sess.] 4 p.	(e)	(e)	.....
Supplemental estimates of appropriations, Department of Commerce, same to be made available and to remain available until expended. Apr. 5, 1917. [Printed as H. doc. 5, 65th Cong. 1st sess.] 4 p.	(e)	(e)	.....
Estimate of appropriation for additional watchmen and guards, Department of Commerce, for balance of fiscal year 1917 and for fiscal year 1918. Apr. 9, 1917. [Printed as H. doc. 12, 65th Cong. 1st sess.] 2 p.	(e)	(e)	.....
Estimates of appropriation, Coast and Geodetic Survey and Bureau of Standards. Apr. 23, 1917. [Printed as H. doc. 55, 65th Cong. 1st sess.] 3 p.	(e)	(e)	6.48
Additional estimates of appropriation, salaries, Bureau of Lighthouses, 1918, and equipment, chemical laboratory, Bureau of Standards, 1917 and 1918. Apr. 24, 1917. [Printed as H. doc. 65, 65th Cong. 1st sess.] 3 p.	(e)	(e)	7.05
Estimate of appropriation for introduction of new fish and other aquatic foods. Apr. 27, 1917. [Printed as H. doc. 72, 65th Cong. 1st sess.] 2 p.	(e)	(e)	4.47

• None printed for the Department.

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## OFFICE OF THE SECRETARY—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Facts regarding need of proper building for Bureau of Fisheries. May 4, 1917. [Printed as H. doc. 117, 65th Cong. 1st sess.] 3 p.	(e)	(e)	\$6.23
Changes in certain deficiency estimates of Department, fiscal year 1917 and prior years. May 4, 1917. [Printed as H. doc. 118, 65th Cong. 1st sess.] 3 p.	(e)	(e)	5.62
Additional estimate of appropriation, seal and salmon fisheries of Alaska, 1918. May 3, 1917. [Printed as H. doc. 163, 65th Cong. 1st sess.] 5 p.	(e)	(e)	16.24
Estimate of appropriation for special regulation of commerce, Department of Commerce, fiscal years 1917 and 1918. June 27, 1917. [Printed as H. doc. 211, 65th Cong. 1st sess.] 3 p.	(e)	(e)	.....

## BUREAU OF THE CENSUS.

Annual report of Director, 1916. 31 p.	2,500	2,415	\$113.51
Cotton production and distribution, season of 1915-16. (Bulletin 134.) 99 p. 14 text fig. 94x114"	45,000	43,000	3,857.36
Cotton production in United States, crop of 1916. 43 p.	41,000	40,912	1,014.96
Instructions to special agents, cotton statistics. July 2, 1917. 16 p. 44x78"	2,500	825	74.28
Act authorizing Director to collect and publish statistics of cotton and cottonseed products. [Reprint of Public. No. 177, 64th Cong.] 2 p.	5,000	2,000	4.65
Financial statistics of States, 1915. 125 p. 94x114"	5,000	4,200	2,145.79
Financial statistics of cities having population of over 30,000, 1915. 338 p. map, 20 text fig. 94x114"	7,500	7,300	8,661.53
Same, abstract. (Bulletin 132.) 117 p. map, 5 text fig. 94x114"	3,000	2,000	567.86
Mortality statistics, [calendar year] 1914. 15th annual report. 714 p. 8 text fig. 94x114"	6,000	5,600	16,153.00
Same, 1915. 16th annual report. 707 p. 10 text fig. 94x114"	5,000	4,400	14,915.85
Mortality from cancer and other malignant tumors in registration area of United States. 212 p. 5 text fig. 94x114"	2,000	1,300	4,048.21
Physicians' pocket reference to International list of causes of death. 3d edition. 1916. 28 p. 1 text fig. 3x6"	200,000	178,000	1,691.40
Manual of International list of causes of death, based on 2d decennial revision by International commission, Paris, July 1-3, 1909. 2d reprint [with corrections and additions]. 300 p.	500	400	280.20
United States life tables, 1910. 1916. [Reprint.] 65 p. 94x114"	10,000	6,500	562.81
Blind in United States, 1910. [Includes summary of State laws relative to blind and prevention of blindness.] 342 p. 6 text fig. 94x114"	4,000	3,600	7,208.06
Religious bodies, 1906: pt. 1, Summary and general tables. (Special reports.) [Reprint.] 576 p. 9 text fig. 94x114"	500	410	577.80
Same: pt. 2, Separate denominations; History, description, and statistics. (Special reports.) [Reprint.] 670 p. 94x114"	500	415	636.85
Instructions to special agents, statistics of divorce. June 1, 1917. 12 p. 44x64"	3,500	.....	64.44
Marriage and divorce, 1887-1906. (Bulletin 96, 2d edition, revised and enlarged.) [Reprint.] 99 p. 14 text fig. 94x114"	500	85	79.50
Instructions to special agents, census of transportation by water, 1916. 25 p. 44x78"	300	295	58.24
Plantation farming in United States. 40 p. 1 text fig. 94x114"	3,000	2,630	596.22
Estimates of population of United States, 1910-1916, including results of State enumerations made in 1915. (Bulletin 133.) 46 p. 2 text fig. 94x114"	7,000	2,850	948.21
Special census of population, Shreveport, La., Feb. 15, 1917. 8 p.	300	220	30.71
Study of cartage costs in city of Washington; prepared by Eugene F. Hartley. 1917. 14 p.	2,000	1,200	68.21
Story of the census, 1790-1916. 40 p. 23 text fig. 54x8"	5,000	1,500	304.34
Tentative program of Bureau, 1916-1919. July 1, 1916. ([Circular] 5.) 14 p.	5,000	4,800	74.57
Circular of information concerning Census publications, 1790-1916. Jan. 1, 1917. ([Circular] 2.) 124 p.	3,000	1,000	745.97
Federal registration service of United States: Its development, problems, and defects; prepared for 2d Pan American Scientific Congress, Washington, Dec. 27, 1915-Jan. 8, 1916 [with list of official publications on vital statistics in United States]; by Cressy L. Wilbur. 1916. [Reprint.] 86 p. 13 text fig.	5,000	2,000	151.71
Census of manufactures: General totals for United States, by geographic divisions, States, and industries, 1914, 1909, 1904, and 1899. 26 p.	5,000	5,000	302.16
Same [reprint].	5,000	2,000	68.20
A abstract of census of manufactures, 1914. 722 p. 9 text fig.	10,000	6,700	9,857.07

\* None printed for the Department.

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF THE CENSUS—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Census of manufactures, 1914 [all 9½x11½"]:			
Flour-mill and gristmill products. 20 p. 1 text fig. ....	6,400	5,200	\$429.61
Manufacture of glass. 13 p. ....	1,500	600	155.93
Manufactured ice. 15 p. ....	5,600	4,300	256.31
Power laundries. 28 p. ....	6,500	6,500	514.53
Same [reprint]. ....	2,000	1,800	38.74
Paper and wood pulp. 19 p. ....	2,500	1,300	269.82
Rice cleaning and polishing. 9 p. ....	6,500	6,500	148.49
Same [reprint]. ....	1,500	1,350	19.29
Sugar industry. 12 p. ....	1,300	.....	154.82
Arkansas. 23 p. ....	1,200	800	299.78
Georgia. 27 p. ....	1,800	1,100	423.82
Idaho. 15 p. ....	900	600	193.11
Indiana. 47 p. ....	2,600	2,000	774.01
Louisiana. 27 p. ....	1,300	800	497.36
Mississippi. 19 p. ....	1,200	700	260.89
Nevada. 13 p. ....	900	300	173.34
North Carolina. 25 p. ....	2,600	2,300	366.81
Oregon. 25 p. ....	1,800	1,400	384.94
Rhode Island. 31 p. ....	1,100	700	477.57
South Dakota. 15 p. ....	1,000	750	207.94
Utah. 21 p. ....	1,200	900	289.43
Vermont. 25 p. ....	1,500	1,400	453.97
West Virginia. 25 p. ....	1,900	1,700	406.25
Wyoming. 13 p. ....	600	400	167.07
Thirteenth census, 1910: Statistics of population, agriculture, manufac- tures, and mining for State, counties, cities, and other divisions. [Re- prints of Supplements published in connection with Abstract of census, with index to abstract tables omitted; all 9½x11½"]:			
Arizona. 82 p. 10 text fig. ....	500	100	120.28
Arkansas. 124 p. 7 text fig. ....	500	100	204.73
California. 161 p. 10 text fig. ....	500	50	129.82
Colorado. 131 p. 10 text fig. ....	500	.....	182.91
Delaware. 66 p. 8 text fig. ....	500	.....	108.18
Florida. 101 p. 7 text fig. ....	500	.....	170.22
Idaho. 91 p. 10 text fig. ....	500	.....	126.74
Kentucky. 160 p. 7 text fig. ....	500	.....	235.22
Louisiana. 117 p. 7 text fig. ....	500	.....	180.58
Maryland. 94 p. 7 text fig. ....	500	.....	132.29
Mississippi. 111 p. 7 text fig. ....	500	12	145.45
Montana. 96 p. 10 text fig. ....	500	.....	157.22
Nebraska. 138 p. 8 text fig. ....	500	.....	240.68
New Hampshire. 79 p. 6 text fig. ....	500	.....	125.33
New Mexico. 92 p. 10 text fig. ....	500	15	85.87
North Dakota. 104 p. 8 text fig. ....	500	.....	182.40
Oklahoma. 128 p. 6 text fig. ....	500	.....	207.10
Oregon. 114 p. 10 text fig. ....	500	.....	106.18
Rhode Island. 77 p. 6 text fig. ....	500	.....	115.72
South Carolina. 97 p. 7 text fig. ....	500	17	171.97
South Dakota. 118 p. 8 text fig. ....	500	.....	203.90
Tennessee. 136 p. 7 text fig. ....	500	38	217.62
Utah. 99 p. 10 text fig. ....	500	.....	89.80
Vermont. 74 p. 6 text fig. ....	500	.....	123.73
Virginia. 146 p. 7 text fig. ....	500	100	226.90
Washington. 122 p. 10 text fig. ....	500	.....	107.28
West Virginia. 104 p. 7 text fig. ....	500	.....	171.96
Wyoming. 80 p. 10 text fig. ....	500	.....	132.93
Thirteenth census, 1910: v. 5, Agriculture, 1909 and 1910, general report and analysis. [Reprint.] 927 p. 2 pl. 6 p. of pl. 51 maps, 112 text fig. 9½x11½". ....	500	500	920.03
Same, v. 6, Agriculture, 1909 and 1910, Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, and Montana. [Reprint.] 977 p. 59 text fig. 9½x11½". ....	500	425	723.25
Same, v. 7, Agriculture, 1909 and 1910, Nebraska, Nevada, New Hamp- shire, New Jersey, New Mexico, New York, North Carolina, North Da- kota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming, Alaska, Hawaii, and Porto Rico. [Reprint.] 1,013 p. 63 text fig. 9½x11½". ....	500	400	757.34
Same, v. 10, Manufactures, 1906, reports for principal industries. [Re- print.] 979 p. 42 text fig. 9½x11½". ....	500	430	729.84
Press summaries [52 summaries, nearly all of which related to census of manufactures, 1914; 1 printed twice and 3 reprints of former year]. 1 sheet each. Approx. 8x12". ....	179,150	178,000	798.24



PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## COAST AND GEODETIC SURVEY.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Annual report of Superintendent, 1916. [Printed also as H. doc. 1489, 64th Cong. 2d sess.] 164 p. 32 pl. diag. 20 maps.	2,000	2,000	\$2,604.00
General tide tables, [calendar] year 1917. (Serial 42.) 480 p. 13 text fig.	2,000	1,548	4,582.25
Atlantic coast tide tables for eastern North America, [calendar] year 1917; from General tide tables. (Serial 43.) 187 p. 13 text fig.	6,000	3,826	682.22
Pacific coast tide tables for western North America, eastern Asia, and many island groups, [calendar] year 1917; from General tide tables. (Serial 44.) 145 p.	12,500	12,500	902.76
United States coast pilot, Atlantic coast: pts. 1-2, St. Croix River to Cape Ann [supplement to 3d edition]. Mar. 9, 1917. (Serial 57.) 131.	1,300	300	34.34
Same, pt. 3, Cape Ann to Point Judith; [by Edwin H. Tillman, assisted by John Ross]. 3d edition [revised by Herbert C. Graves, assisted by C. L. Warwick and E. Vance Miller]. 1912. [Reprint.] 166 p. diag. 2 maps. 8x11 $\frac{1}{2}$ "	1,000	491	670.16
Same, pt. 3, Cape Ann to Point Judith [supplement to 3d edition]. Feb. 1, 1917. (Serial 56.) 21 l.	1,000	400	50.98
Same, sec. C, Sandy Hook to Cape Henry, including Delaware and Chesapeake Bays; [by L. A. Potter, under direction of Herbert C. Graves]. (Serial 32.) 1916. 284 p. map.	4,000	1,745	1,982.66
Same, sec. D, Cape Henry to Key West [supplement to]. Sept. 22, 1916. (Serial 52.) 19 l.	1,000	900	47.43
Same. Mar. 16, 1917. (Serial 58.) 22 l.	1,000	200	32.72
Same, sec. E, Gulf of Mexico from Key West to Rio Grande; [by Arthur J. Fla, under direction of R. S. Patton]. (Serial 45.) 1916. 169 p. map.	3,000	1,044	1,320.41
Same, Pacific coast: California, Oregon, and Washington [supplement to 2d edition]. Mar. 16, 1917. (Serial 59.) 20 l.	600	200	42.30
Inside route pilot: New York to Key West, 3d edition, 1916; [by L. A. Potter, under direction of Herbert C. Graves]. (Serial 52.) 94 p. 8 maps (in pocket). 9x11 $\frac{1}{2}$ "	4,000	1,125	1,434.65
Results of observations made at Survey magnetic observatory at Vieques, P. R., 1913-14; by Daniel L. Hazard. (Serial 33.) 102 p. 15 diag. 9x11 $\frac{1}{2}$ "	900	810	1,192.23
Results of magnetic observations made by Survey in 1915; by Daniel L. Hazard. (Special publication 36; serial 36.) 80 p. 7x11 $\frac{1}{2}$ "	1,000	806	500.27
Elements of chart making [with list of books which give detailed information]; by E. Lester Jones. (Special publication 38; serial 47.) 1916. 15 p. 23 pl. 4 diag. 5 maps.	5,000	5,000	991.72
Same [reprint].	5,000	1,026	640.87
Supplement to Regulations and instructions for government of Survey. Jan. 1, 1913-June 30, 1916. (Serial 48.) 20 p.	500	350	52.56
Same. July 1-Dec. 31, 1916. (Serial 55.) 9 p.	500	425	25.66
Precise leveling from Reno to Las Vegas, Nev., and from Tonopah Junction, Nev., to Laws, Cal.; by H. G. Avers and G. D. Cowie. (Special publication 39; serial 49.) 1916. 49 p. 4 maps, 1 text fig.	2,000	803	347.66
Use of mean sea level as datum for elevations; by E. Lester Jones. (Special publication 41; serial 60.) 1917. 21 p.	20,000	16,000	271.92
Investigations of gravity and isostasy [with bibliography]; by William Bowie. (Special publication 40; serial 50.) 1917. 196 p. 9 pl. 9 maps (in pocket). 9x11 $\frac{1}{2}$ "	2,500	863	3,287.37
Tables for polyconic projection of maps, based upon Clarke's reference spheroid of 1866. 4th edition. (Special publication 5.) 1917. 189 p. 1 text fig. 9x11 $\frac{1}{2}$ "	650	281	424.12
Plane table manual; by D. B. Wainwright. Appendix 7 to Report for 1905. (Reprint [with corrections], 1916.) 54 p. 7 litho. 29 pl. 1 text fig. 9x11 $\frac{1}{2}$ "	500	363	164.45
Supplement to Catalogue of charts, coast pilots, and tide tables, 1916. Aug. 30, 1916. (Serial 51.) 6 p. 8x10 $\frac{1}{2}$ "	1,000	800	26.03
Same. Jan. 2, 1917. (Serial 54.) 7 p. 8x10 $\frac{1}{2}$ "	1,000	800	44.46
Coast Survey bulletin [issued monthly, June, 1916-May, 1917, nos. 13-24, various paging]. 130 p.	4,800	4,800	271.10
Rules governing issue of books, original records, and map material from library and archives section. Oct. 1916. (Serial 53.) 2 p.	1,000	700	7.68
Centennial celebration of Survey, Apr. 5 and 6, 1916, Washington, D. C. 196 p. 30 pl. 3 p. of pl. 2 charts, 1 diag. 4 text fig. 7x10"	2,500	2,079	2,396.66
Same, reprints from [all 7x10"]:			
1. Bureau of Fisheries and its relation to Survey; by Hugh M. Smith. 6 p.	1,000	878	(e)
2. Work done by Survey in field of terrestrial magnetism; by Louis A. Bauer. 14 p. diag. 2 charts	1,000	950	(e)
3. Bureau of Standards and its relation to Survey; by S. W. Stratton. 18 p. 2 pl. 2 p. of pl.	1,000	726	(e)
4. Ocean currents and deep-sea explorations of Survey; by J. E. Pillsbury. 9 p.	1,000	825	(e)
5. United States Geological Survey and its relation to Coast and Geodetic Survey; by George Otis Smith. 12 p.	1,000	680	(e)

\* The cost of printing 1,000 copies each of 14 separates is included in the cost of the complete report.

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## COAST AND GEODETIC SURVEY—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Centennial celebration of Survey, reprints from—Continued.			
6. Survey's part in development of commerce; by J. Hampton Moore. 13 p.	1,000	650	(*)
7. United States Corps of Engineers and its relation to Survey; by W. M. Black. 7 p.	1,000	850	(*)
8. Lighthouse Service and its relation to Survey; by George R. Putnam. 8 p.	1,000	700	(*)
9. Hydrography and charts, with special reference to work of Survey; by George Washington Littlehales. 4 p.	1,000	875	(*)
10. Contribution of Survey to geodesy; by William Henry Burger. 12 p.	1,000	600	(*)
11. Civil war record of Survey, and what Survey is doing toward preparedness; by Richard Wainwright. 6 p.	1,000	400	(*)
12. International work of Survey; by Otto Hilgard Tittmann. 9 p.	1,000	800	(*)
13. Ocean tides, with special reference to work of Survey; by Charles Lane Poor. 13 p. 1 p. of pl. 3 text fig.	1,000	325	(*)
14. Contributions of Survey to science of physical geography; by Douglas Wilson Johnson. 11 p.	1,000	550	(*)
Reports and returns required of field officers. Oct. 3, 1916. (Circular 37.) 4 p. 5x7½"	350	150	\$10.59
Instructions relating to accounting for and handling of instruments, general property, surgical instruments, and medical supplies. June 1, 1917. (Circular 44.) 16 p.	600	375	50.83
Instructions as to procedure in procuring proposals and in awarding contracts for articles, services, hire of boats, and repairs to vessels and equipment. Apr. 11, 1917. 5 p.	500	450	15.67
Expenditures in Survey, fiscal year 1916. Dec. 18, 1916. [Reprint of H. doc. 1762, 64th Cong. 2d sess.] 15 p.	150	150	1.20
Coast and Geodetic Survey [extract from Public, No. 132, 64th Cong., making appropriations for sundry civil expenses, fiscal year 1917]. 3 p.	300	300	6.75
Requisition for stationery. 4 p. 8x11"	3,000	1,800	92.48
Repairs, additions, and alterations to vessels. [Advertisement, proposal, acceptance, guaranty, instructions, conditions, specifications, and report on completion of work.] 16 p. 7½x10½"	1,000	245	164.58
Same. [Contract, bond, bondsmen's oaths, certificate of solvency, and certificate to be used where contractor is corporation.] 4 p. 7½x10½"	1,000	425	
Synopsis of signal systems based upon dot and dash and 2-arm semaphore codes of Navy. [Reprint of circular issued by Navy Department.] 4 p. [with illustrations showing semaphore code]. 8x10½"	250	210	4.26

## BUREAU OF FISHERIES.

Bulletin, v. 34, 1914. [Printed also as H. doc. 1716, 63d Cong. 3d sess.] 461 p. 45 pl. 35 p. of pl. 26 maps, 136 text fig. 7½x10½"	250	163	\$680.22
CONTENTS.—Fur seals and other life of Pribilof Islands, Alaska, in 1914 [with bibliography]; by Wilfred H. Osgood, Edward A. Preble, and George H. Parker.—Changes in shade, color, and pattern in fishes, and their bearing on problems of adaptation and behavior, with especial reference to flounders <i>Paralichthys</i> and <i>Ancyllopsetta</i> [with bibliography]; by S. O. Mast.—Sharks and rays of Beaufort, N. C. [with bibliography]; by Lewis Radcliffe.—Structure and growth of scales of squeteague and pigfish as indicative of life history [with bibliography]; by Harden F. Taylor.—Copepod parasites of freshwater fishes and their economic relations to mussel <i>Glochidia</i> ; by Charles Branch Wilson.—Fishes of streams tributary to Tomales Bay, Cal.; by John Otterbein Snyder.—Fairport fisheries biological station, its equipment, organization, and functions; by Robert E. Coker.—Notes on embryology and larval development of 5 species of teleostean fishes; by Albert Kuntz.—Notes on fishes of east Tennessee; by Barton Warren Evermann and Samuel F. Hildebrand.—Index.			
Same [title-page, contents, and index only]. 8 p. 7½x11"	50	65	44.54
Bureau of Fisheries documents:			
346. Artificial propagation of Atlantic salmon, rainbow trout, and brook trout. [From Fish manual.] [Reprint.] 76 p. 13 pl. 5 p. of pl. map, 20 text fig.	500	432	79.98
519. Artificial propagation of salmon of Pacific coast. [From Fish manual.] [Reprint.] 17 p. 7 pl. 1 p. of pl.	500	407	27.99
520. Artificial propagation of lake trout, grayling, and whitefish. [From Fish manual.] [Reprint.] 32 p. 5 pl. 4 p. of pl. poster, 4 text fig.	1,000	509	59.42

\* The cost of printing 1,000 copies each of 14 separates is included in the cost of the complete report.

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF FISHERIES—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Bureau of Fisheries documents—Continued.			
521. Artificial propagation of shad and pike perch. [From Fish manual.] [Reprint.] 61 p. 8 pl. 1 p. of pl. 5 text fig. ....	500	430	\$42.72
522. Artificial propagation of marine species. [From Fish manual.] [Reprint.] 46 p. 9 pl. 1 p. of pl. 1 text fig. ....	1,000	392	62.49
733. American catfishes: Habits, culture, and commercial importance; by William Converse Kendall. [From Report of Commissioner, 1908.] [Reprint.] 39 p. 10 pl. ....	500	500	25.42
Same [reprint]. ....	500	480	25.72
823. Structure and growth of scales of squeteague and pigfish as indicative of life history [with bibliography]; by Harden F. Taylor. Sept. 23, 1916. [From Bulletin, v. 34.] 48 p. 1 pl. 9 p. of pl. 8 text fig. 74x11" .....	1,500	1,103	498.74
826. Fish ponds on farms; by Robert S. Johnson and M. F. Stapleton. [App. 2, Report of Commissioner, 1915.] [Reprint.] 30 p. 18 pl. 1 p. of pl. ....	500	500	51.49
Same [reprint]. ....	2,500	2,452	112.27
829. Fairport fisheries biological station: Its equipment, organization, and functions; by Robert E. Coker. July 7, 1916. [From Bulletin, v. 34.] 25 p. 2 pl. 4 p. of pl. map, 8 text fig. 74x11" .....	1,500	1,500	262.67
830. Pacific cod fisheries [with bibliography]; by John N. Cobb. [App. 4, Report of Commissioner, 1915.] 113 p. 1 pl. 8 p. of pl. map. ....	1,500	1,343	680.21
831. Notes on embryology and larval development of 5 species of teleostean fishes; by Albert Kuntz. Aug. 3, 1916. [From Bulletin, v. 34.] 25 p. 68 text fig. 74x11" .....	1,500	1,320	223.09
832. Notes on fishes of east Tennessee; by Barton Warren Evermann and Samuel F. Hildebrand. [From Bulletin, v. 34.] 23 p. 13 text fig. 74x11" .....	1,500	1,401	152.41
833. Explorations of United States Coast and Geodetic Survey steamer Bache in western Atlantic, Jan.-Mar. 1914, under direction of Bureau of Fisheries—Oceanography [with bibliography]; by Henry B. Bigelow. [App. 5, Report of Commissioner, 1915.] 62 p. map, 53 text fig. ....	850	702	336.85
834. Alaska fisheries and fur industries in 1915; by Ward T. Bower and Henry D. Aller. [App. 3, Report of Commissioner, 1915.] 140 p. 5 text fig. ....	1,500	1,363	682.66
835. Survey of fishing grounds on coast of Washington and Oregon in 1915; by Edward C. Johnston. [App. 6, Report of Commissioner, 1915.] 22 p. 4 charts. ....	1,500	1,475	253.45
836. Annual report of Commissioner, 1916. 114 p. ....	2,500	2,063	603.63
836a. Investigation, experiments, and surveys relative to aquatic resources of United States conducted by Bureau, fiscal year 1916. [Extract from Report of Commissioner, 1916.] 17 p. ....	500	231	12.44
836b. Commercial fisheries of United States and operations of Bureau of Fisheries in connection therewith, fiscal year 1916. [Extract from Report of Commissioner, 1916.] 52 p. ....	500	222	22.76
837. Distribution of fish and fish eggs, fiscal year 1916; [by] Henry O'Malley. [App. 1, Report of Commissioner, 1916.] 112 p. ....	1,250	740	988.71
839. Pacific salmon fisheries; by John N. Cobb. [App. 3, Report of Commissioner, 1916.] 255 p. 13 pl. 16 p. of pl. ....	1,250	1,117	1,560.54
840. Fish laws of Mississippi River States: Digest of statutes relating to protection of fish and miscellaneous aquatic animals of States bordering on Mississippi River; by Emerson Stringham. [App. 4, Report of Commissioner, 1916.] 16 p. ....	1,250	951	76.00
841. Condition and extent of natural oyster beds and barren bottoms in vicinity of Apalachicola, Fla.; by Ernest Danglede. [App. 5, Report of Commissioner, 1916.] 68 p. 5 pl. 2 p. of pl. chart. ....	1,250	913	583.91
842. Historical basis of adaptive shades and colors in the flounder <i>Paralichthys aibiquitus</i> [with bibliography]; by Albert Kuntz. [From Bulletin, v. 35.] 29 p. 2 p. of pl. 8 text fig. 74x11" .....	850	739	371.43
844. Fishing in Priamur district of Siberia; by John K. Caldwell. [App. 6, Report of Commissioner, 1916.] 31 p. ....	850	727	120.21
848. Mortality of fishes on west coast of Florida [with bibliography]; by Harden F. Taylor. [App. 3, Report of Commissioner, 1917.] 24 p. 1 pl. 3 p. of pl. ....	850	747	106.24
Economic circulars:			
5. Artificial propagation of diamond-back terrapin; [by W. F. Hay]. [Reprinted and revised] Mar. 17, 1917. 22 p. 5 text fig. ....	2,000	165	89.57
6. Mussel fisheries of Caddo Lake and Cypress and Sulphur Rivers of Texas and Louisiana; [by Austin F. Shira]. Dec. 10, 1913. [Reprint.] 10 p. ....	800	129	32.92
11. Canned salmon, cheaper than meats, and why; including 60 tested recipes. Mar. 7, 1914. [Reprint.] 11 p. ....	5,000	5,000	32.16
18. Oysters, food that has not "gone up," a little of their history and how to cook them; [by H. F. Moore]. Aug. 26, 1915. [Reprint.] 16 p. ....	2,500	2,500	14.04
Same [reprint]. ....	5,000	5,000	35.80
Same [reprint]. ....	5,000	2,668	32.16

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF FISHERIES—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
<b>Economic circulars—Continued.</b>			
21. Information concerning parasitic worms in fish. Oct. 14, 1916. 4 p.....	10,000	374	\$27.22
22. Grayfish; try it; it knocks H out of the H. C. of L. Nov. 29, 1916. 8 p. 1 text fig.....	10,000	10,000	61.60
Same [reprint].....	10,000	10,000	34.32
Same [reprint].....	15,000	15,000	46.63
Same [reprint].....	25,000	5,702	76.04
23. Sablefish, alias black cod; [by H. F. Moore]. Introduction to one of best and richest of American food fishes, with recipes for cook- ing it. Mar. 8, 1917. 6 p. 1 text fig.....	20,000	20,000	83.70
Same [reprint].....	20,000	3,468	64.27
24. Question of fishways; [by R. E. Coker]. May 8, 1917. 6 p.....	1,000	604	22.00
25. Burbot, fresh-water cousin to cod; [by H. F. Moore]. May 9, 1917. 4 p. 1 text fig.....	25,000	8,394	80.56
26. Bowfin, old-fashioned fish with new-found use; [by R. E. Coker]. May 11, 1917. 4 p. 1 text fig.....	25,000	1,993	56.75
27. Practical small smokehouse for fish, how to construct and operate it; [based on experiments by J. B. Southall]. May 17, 1917. 7 p. 3 text fig.....	5,000	2,886	51.21
28. Preserving fish for domestic use; [by H. F. Moore]. May 26, 1917. 2 p.....	100,000	7,097	75.98
<b>Fisheries Service bulletin</b> [issued monthly, July, 1916-June, 1917, nos. 14-25; 4-11 p. each]. 106 p.....	10,000	10,000	351.21
Same [reprint of March number]. 8 p.....	600	600	21.03
Proposal for supplies, Pribilof Islands, Alaska, 1917 [with contract and bond]. 106 p. 7½x10½".....	500	500	773.83
Work of Bureau and its fish-cultural station at Boothbay Harbor, Me. 13 p. 6 text fig.....	1,500	1,500	62.19
<b>Quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels</b> [is- sued monthly, June, 1916-May, 1917; statistical bulletins 354, 357, 359, 361, 363, 364, 367, 371, 374, 376, 378, 380]. 12 numbers. 1 sheet each. Approx. 32x14".....	3,600	3,000	491.98
<b>Quantities and values of certain fishery products landed at Seattle, Wash., by American fishing vessels and fishery products taken in Puget Sound and landed at Seattle, Wash., by collecting vessels</b> [issued monthly, June, 1916-May, 1917; statistical bulletins 353, 356, 358, 360, 362, 365, 366, 372, 373, 375, 377, 379]. 12 numbers. 1 sheet each. 10½x5".....	3,600	3,000	103.45
<b>Coastal fisheries of New York and New Jersey, by counties, exclusive of shellfish, 1915, and shad fishery of Hudson River, 1915 and 1916.</b> (Sta- tistical bulletin 355.) 1 sheet. 16x21".....	1,800	1,400	44.91
<b>Quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels, calendar year 1916, by months.</b> (Statistical bulletin 368.) 1 sheet. 8½x12".....	500	450	56.68
Same, by fishing grounds. (Statistical bulletin 369.) 1 sheet. 38x20".....	500	450	84.56
<b>Quantities and values of certain fishery products landed at Seattle, Wash., by American fishing vessels, calendar year 1916, by fishing grounds and by months, and fishery products taken in Puget Sound and landed at Seattle, Wash., by collecting vessels, calendar year 1916, by months.</b> (Statistical bulletin 370.) 1 sheet. 18x16".....	500	450	36.00

## BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

<b>Annual report of Chief, 1916.</b> 97 p.....	2,500	2,241	\$348.15
<b>Position of United States in world trade.</b> [From Report of Chief of Bureau, 1916.] 14 p.....	200	200	6.29
<b>Foreign tariff notes, no. 20.</b> [From Commerce reports, Jan.-Mar. 1916.] 48 p.....	1,500	1,267	124.91
Same, no. 21 [with cumulative index for nos. 18-21]. [From Commerce reports, Apr.-June, 1916.] 50 p.....	1,500	1,199	152.09
Same, no. 22. [From Commerce reports, July-Sept. 1916.] 49 p.....	1,000	815	123.69
Same, no. 23. [From Commerce reports, Oct.-Dec. 1916.] 42 p.....	1,000	301	116.23
<b>Need for use of our interior waterways.</b> [From Commerce reports, June 13, 1917.] 4 p.....	20,000	20,000	39.04
<b>Commerce reports</b> [issued daily except Sundays and legal holidays, July 1, 1916-June 30, 1917, 305 issues, 16-32 p. each]. 4,896 p.....	1,565,575	1,565,575	24,385.21
Same, [title-page and index to] nos. 1-76, v. 1 [series 1916]; Jan.-Mar. 1916. 76 p.....	1,000	1,000	483.29
Same, [title-page and index to] nos. 77-153, v. 2 [series 1916]; Apr.-June, 1916. 57 p.....	1,000	1,000	382.80
Same, [title-page and index to] nos. 154-230, v. 3 [series 1916]; July-Sept. 1916. 54 p.....	1,000	1,000	348.07

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF FOREIGN AND DOMESTIC COMMERCE—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Commerce reports, [title-page and index to] nos. 231-306, v. 4 [series 1916]; Oct.-Dec. 1916. 64 p.	1,000	1,000	\$337.63
Same, [title-page and index to] nos. 1-75, v. 1 [series 1917]; Jan.-Mar. 1917. 40 p.	1,100	1,006	265.43
Same, supplements (containing annual reports of United States consular officers on commercial conditions in foreign countries; 110 issues, various paging). 1,761 p.	554,900	554,900	17,145.19
Same [reprint of supplement no. 23b, Mar. 11, 1915]. 14 p.	200	200	
Same [reprint of supplement no. 38b, Apr. 17, 1915]. 22 p.	200	200	
Same [reprint of supplement no. 46a, July 27, 1915]. 23 p.	200	200	184.63
Same [reprint of supplement no. 56b, Mar. 4, 1915]. 14 p.	200	200	
Same, [v. 1 and 2, title-pages, contents, and] index. [v. 1 covers Europe, and v. 2 all other countries. Index for both volumes included in one publication.] 26 p.	2,000	2,000	188.57
Classification of countries for tables of imports and exports. [Schedule C.] [From Foreign commerce and navigation, 1915.] [Reprint.] 21. 9x11 1/2".	200	200	2.39
Foreign commerce and navigation of United States, year ending June 30, 1916. [Printed also as H. doc. 1486, 64th Cong. 2d sess.] 1,006 p. 9x11 1/2".	1,800	1,351	18,547.43
Separates reprinted from Foreign commerce and navigation, 1916 [all 9x11 1/2"]:			
Classification of countries for tables of imports and exports. [Schedule C.] 21.	600	600	3.71
Imports of merchandise, by articles and countries, 1912-1916. [Table 3.] 281 p.	800	224	243.45
Exports of domestic merchandise, by articles and countries, 1912-1916. [Table 5.] 406 p.	700	185	350.91
Imported merchandise entered for consumption in United States and duties collected thereon, 1916: Total values of imported merchandise entered for consumption, by customs districts. [Summary tables and Tables 9-10.] 57 p.	900	333	70.86
Monthly summary of foreign commerce of United States [May, 1916-Apr. 1917, 12 numbers; printed also as H. doc. 45, pt. 11-12, 64th Cong. 1st sess., and H. doc. 1501, pt. 1-10, 64th Cong. 2d sess.; all 9x11 1/2"]:			
May, 1916. 86 p.	2,700	2,700	1,561.41
June, 1916. 86 p.	2,700	2,700	1,561.95
July, 1916. 92 p.	2,750	2,726	1,744.68
Aug. 1916. 92 p.	2,750	2,745	1,744.94
Sept. 1916. 92 p.	2,750	2,722	1,701.02
Oct. 1916. 92 p.	2,750	2,739	1,750.91
Nov. 1916. 92 p.	2,800	2,800	1,744.00
Dec. 1916. 92 p.	3,000	2,897	1,656.66
Jan. 1917. 92 p.	2,800	2,800	1,645.14
Feb. 1917. 92 p.	2,800	2,735	1,702.44
Mar. 1917. 92 p.	2,800	2,637	1,714.49
Apr. 1917. 92 p.	2,800	2,666	1,968.65
Statistical abstract of United States, 1915. no. 38. [Printed also as H. doc. 443, 64th Cong. 1st sess.] [Reprint.] 749 p.	300	300	259.85
Same, 1916. no. 39. [Printed also as H. doc. 1879, 64th Cong. 2d sess.] 773 p.	2,700	2,563	5,188.06
Special agents series:			
117. Lumber markets of west and north coasts of South America; by Roger E. Simmons. 149 p. 10 p. of pl. map.	1,300	1,079	716.11
118. Markets for machinery and machine tools in Peru, Bolivia, and Chile; by J. A. Massel. 88 p.	1,000	896	302.92
120. Cotton goods in Dutch East Indies; by Ralph M. Odell. 55 p. 2 p. of pl. map.	1,000	942	243.97
121. Artificial dyestuffs used in United States: Quantity and value of foreign imports and of domestic production, fiscal year 1914; by Thomas H. Norton. 254 p. 2 p. of pl. 2 diag. 2 text fig.	1,000	601	2,289.64
122. Development of American linen industry; by W. A. Graham Clark. 23 p.	1,000	726	64.02
123. Cotton goods in Ceylon; by Ralph M. Odell. 39 p.	1,000	921	135.01
124. Cotton goods in British India: pt. 1, Madras Presidency; by Ralph M. Odell. 50 p.	1,000	403	193.40
125. Markets for agricultural implements and machinery in Argentina; by Frank H. von Moltz. 86 p.	1,000	815	261.71
126. Textiles in Cuba; by W. A. Tucker. 56 p.	1,000	339	220.10
127. Cotton goods in British India: pt. 2, Bengal Presidency; by Ralph M. Odell. 88 p.	1,000	337	324.64
128. Electrical goods in Cuba; by Philip S. Smith. 40 p.	1,000	176	131.83
129. Danish West Indies: Their resources and commercial importance; by H. G. Brock, Philip S. Smith, and W. A. Tucker. 68 p. 1 pl. 4 p. of pl. map.	1,000	732	209.45
130. Wearing apparel in Japan; by Stanhope Sams. 134 p. 2 p. of pl.	1,000	254	504.10
131. South American markets for fresh fruits; by Walter Fischer. 163 p. 1 pl. 6 p. of pl.	1,000	258	572.32
132. Markets for paper, paper products, and printing machinery in Cuba and Panama; by Robert S. Barrett. 44 p.	1,000	271	136.46
133. Market for boots and shoes in Cuba; by Herman G. Brock. 46 p.	1,000	322	119.49

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF FOREIGN AND DOMESTIC COMMERCE—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
<b>Special agents series—Continued.</b>			
134. Electrical goods in Porto Rico; by Philip S. Smith. 16 p. ....	1,000	266	\$44.80
135. Market for boots and shoes in Porto Rico; by Herman G. Brock. 28 p. ....	1,000	266	83.76
136. Pilotage in United States [with bibliography]; by Grosvenor M. Jones. 102 p. ....	1,000	360	356.17
137. Textiles in Porto Rico and Jamaica; by W. A. Tucker. 31 p. ....	1,000	321	75.93
138. Cotton goods in British India: pt. 3, Burma; by Ralph M. Odell. 52 p. 2 p. of pl. ....	1,000	214	203.69
139. Markets for construction materials and machinery in Cuba; by W. W. Ewing. 61 p. ....	1,000	244	166.88
140. Markets for agricultural implements and machinery in Brazil; by Frank H. von Motz. 59 p. 2 p. of pl. ....	1,000	332	239.67
142. Markets for agricultural implements and machinery in Chile and Peru; by Frank H. von Motz. 48 p. ....	1,000	254	123.42
<b>Special consular reports:</b>			
47. Australia: Its resources, industries, and trade, with suggestions as to its development as market for American merchandise; by Henry D. Baker and other consular officers. [Reprint.] 126 p. ....	500	57	39.15
61. Russia: Handbook on commercial and industrial conditions [with bibliography], by John H. Snodgrass and other consular offi- cers; [and Foreign corporations in Russia, by C. J. Medizh- howsky]. [Reprint.] 255 p. 2 maps. ....	200	91	120.67
75. Foreign trade in buttons [with list of foreign button dealers and importers]. 184 p. ....	1,200	601	658.02
76. Proprietary medicine and ointment trade in China; by Thomas Sammons. 12 p. ....	1,000	337	27.09
<b>Tariff series:</b>			
24b. Supplement to [Tariff series 24] Consular regulations of foreign countries [Canada and Latin America]. Apr. 1917. 7 p. ....	1,000	505	32.38
30a. Supplement to [Tariff series 30] Foreign import duties on motor vehicles and accessories. June, 1917. 17 p. ....	1,000	812	116.44
31. Registration of trade-marks in Latin America. [Revised pre- liminary report.] July, 1916. 8 p. ....	5,000	1,707	36.02
24. Tariff systems of South American countries; by Frank R. Rutter. 308 p. ....	1,500	1,500	1,260.07
35. Commercial travelers in Latin America; [by] L. Domeratzky. Oct. 1916. 42 p. ....	1,000	1,000	154.36
<b>Miscellaneous series:</b>			
28. Commercial organizations of United States. [Revision of Mis- cellaneous series 8.] [Reprint.] 104 p. ....	200	200	24.54
33. Ports of United States: Terminal facilities, commerce, port charges, and administration of 68 selected ports; by Grosvenor M. Jones. [Reprint.] 431 p. 1 pl. 20 maps. ....	1,000	717	335.50
35. Export trade suggestions: Extracts from reports of American consular officers and data from other sources dealing with promotion of American trade. [Reprint.] 141 p. 2 text fig. ....	1,000	256	62.95
38. Trade of United States with world, 1914-15: Imports and exports of merchandise into and from United States, by countries and principal articles. 247 p. ....	1,000	864	2,384.27
39. Peruvian markets for American hardware; prepared under super- vision of United States commercial attaché at Lima, Peru. 64 p. 1 pl. 2 p. of pl. ....	1,000	338	311.63
41. Markets for American hardware in Chile and Bolivia; prepared under supervision of Verne L. Havens. 190 p. 1 pl. 4 p. of pl. map, 1 text fig. ....	1,000	353	675.11
42. Australian markets for American hardware; prepared under supervision of William C. Downs. 105 p. ....	1,000	471	460.67
43. Markets for American hardware in Argentina, Uruguay, and Paraguay; prepared under supervision of Albert Hale. 64 p. 1 pl. ....	1,000	364	255.51
44. Trans-Pacific shipping; by Julian Arnold [with section on Jap- anese shipping, by M. D. Kirjasoff]. 30 p. ....	1,000	940	141.32
45. Exporting to Australia: Practices and regulations to be observed by American shippers; by Philip B. Kennedy. 29 p. ....	1,000	833	85.25
46. Russian market for American hardware; prepared under super- vision of Henry D. Baker. 111 p. 4 p. of pl. ....	1,000	339	434.49
47. Brazilian markets for American hardware; prepared under super- vision of Lincoln Hutchinson. 89 p. 1 pl. ....	1,000	611	339.98
48. Markets for American hardware in Germany, Netherlands, and Scandinavia; prepared under supervision of Erwin W. Thomp- son. 126 p. ....	1,000	272	475.93
49. Markets for American hardware in France, Algeria, and Morocco; prepared under supervision of C. W. A. Veditz. 61 p. ....	1,000	274	316.14
50. Far Eastern markets for American hardware; prepared under su- pervision of Julian Arnold. 145 p. 1 pl. 8 p. of pl. ....	1,000	327	629.66
51. Lumber markets of Mediterranean region and the Near East [with supplementary material compiled by research division, Bureau of Foreign and Domestic Commerce]; by Raphael Zon. 31 p. ....	1,000	247	118.59

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF FOREIGN AND DOMESTIC COMMERCE—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
<b>Miscellaneous series—Continued.</b>			
52. Wholesale prices of leading articles in United States markets, Jan. 1914-Dec. 1916. 14 p.	1,000	317	394.56
53. Cane sugar industry: Agricultural, manufacturing, and marketing costs in Hawaii, Porto Rico, Louisiana, and Cuba. 462 p.	1,000	1,000	2,065.37
56. Consumption estimates: Production, imports, exports, and amounts available for consumption of various articles in United States, by years specified. [From Statistical abstract, 1916.] 14 p.	500	211	7.98
58. Cotton textiles: International trade and merchandising methods; prepared for Textile Club of New York by Edward Ewing Pratt. 19 p.	1,000	242	52.61
59. Methods of computing values in foreign trade statistics; by J. J. Kral. 23 p.	1,000	292	76.81
Monthly letter: Review of Bureau's activities at home and abroad. [July 1, 1916-June 1, 1917, 12 numbers, 14-20 p. each.] 192 p.	2,875	2,875	374.26
Government assistance to American exporters, 1917. [List of district and cooperating offices on title-page.] 8 p. 3½x8½"	18,000	17,500	60.23
Saving of waste paper material: How to select, assort, and dispose of waste paper, rags, and other paper-making material. [Issued in collaboration with Department of Agriculture.] May 10, 1916. [Reprint with corrections.] 8 p. 3 text fig.	10,000	10,000	42.67
Same [reprint].	5,000	5,000	17.83
Same [reprint].	4,000	451	14.98
(Classification schedule. [Reprint from Miscellaneous series 22, Trade directory of Central America and West Indies.] 11 p.	400	400	5.53
List of publications [of Bureau] for sale by Superintendent of Documents, Government Printing Office, Washington, and by district and cooperative offices of Bureau. [July 24, 1916.] 10 p. 3½x7½"	15,000	15,000	81.74
Same. May 14, 1917. 11 p. 3½x7½"	5,000	3,000	52.15
Supplement to catalogue of Bureau publications. Mar. 1, 1917. 4 p.	1,000	500	18.98
Substitutes for tin cans: How to offset any possible shortage. [Issued in collaboration with Bureau of Standards.] 4 p.	50,000	39,000	80.45
Appointments to positions at home and abroad in Bureau. [Feb. 17, 1917.] 23 p. 3½x7½"	1,000	1,000	37.90
Same [reprint].	5,000	3,500	41.14
Total values of imports and exports of United States [issued monthly, June, 1916-May, 1917, 12 numbers, 2 p. each.] 24 p. 9½x11½"	14,350	14,350	175.63
Exports of domestic breadstuffs, cottonseed oil, food animals, meat and dairy products, cotton, and mineral oils [issued monthly, May, 1916-Apr. 1917, 12 numbers, 4 p. each.] 48 p. 9½x11½"	13,700	13,700	724.23
Imported merchandise entered for consumption in United States and duties collected thereon during quarters ending Sept. 30 and Dec. 31, 1915, and Mar. 31, 1916. 113 p. 9½x11½"	850	846	942.19
Same, quarters ending Sept. 30 and Dec. 31, 1915, and Mar. 31 and June 30, 1916. 111 p. 9½x11½"	900	900	452.14
Same, quarter ending Sept. 30, 1916. 58 p. 9½x11½"	850	850	902.85
Same, quarters ending Sept. 30 and Dec. 31, 1916. 58 p. 9½x11½"	850	850	395.76
Schedule B. (Classifications of commodities and laws and regulations governing preparation of monthly statements of imports and exports of foreign commodities in commerce of United States; approved June 9, 1915. [Reprint.] 36 p.	3,000	2,990	42.63
Schedule B. Classification of commodities and regulations governing statistical returns of exports of domestic commodities, and shipments between United States and its noncontiguous territory; approved May 25, 1917. 23 p.	5,000	500	216.06
Foreign commerce and the tariff, 1899-1915, in response to resolution, information regarding value of imports, exports, and import duties under present and two preceding tariff acts, value of imports, compared with value of domestic production, and expenditure for wages in each in industry before outbreak of European war, and imports and exports of leading manufacturing countries during recent years. Mar. 24, 1916. [S. doc. 366, 64th Cong. 1st sess.] [Reprint.] 75 p.	500	300	22.15

## BUREAU OF LIGHTHOUSES.

Annual report of Commissioner, 1916. 99 p.	1,500	1,420	3691.41
Same, pt. 2, Purchases in open market or by private contract, with reasons for such method of purchase, fiscal year 1916. 44 p.	75	75	352.04
Notice to mariners [issued weekly, jointly with Coast and Geodetic Survey, July 7, 1916-June 29, 1917, nos. 27-52+1-26, 52 numbers]. 663 l.	170,700	170,700	3,584.29
Same [for posting, Atlantic coast nos. 34-53, Pacific coast nos. 1, 19, 20; 23 notices, each 10½x16½". 23 l.	20,400	20,400	180.43
Lighthouse Service bulletin [issued monthly, July, 1916-June, 1917, nos. 55-66, 12 numbers, 4-8 p. each]. 52 p.	18,000	18,000	205.51
Light list, Atlantic and Gulf coasts of United States. [Includes also Porto Rico and Cuba.] Corrected to Jan. 1, 1917. 392 p.	10,000	9,158	4,270.86

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF LIGHTHOUSES—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Light list, Pacific coast, United States, Canada, Hawaiian, [Midway, Guam] and Samoan Islands. Corrected to Jan. 1, 1917. [Of Samoan Islands only Tutuila is included in this publication.] 169 p.	2,700	2,437	\$1,289.00
Same, Great Lakes, United States and Canada. Corrected to Apr. 1, 1917. 215 p.	2,500	1,321	849.69
Same, upper Mississippi River and tributaries. 13th lighthouse district. Corrected to July 15, 1916. 271 p. 3½x6½"	1,200	1,200	583.81
Same, Ohio, Tennessee, Kanawha, and Monongahela Rivers. 14th lighthouse district. Corrected to Sept. 15, 1916. 141 p. 3½x6½"	1,200	988	546.21
Same, lower Mississippi River and tributaries. 15th lighthouse district. Corrected to Oct. 15, 1916. 107 p. 3½x6½"	1,000	873	126.88
Atlantic coast of United States, buoy list, Maine and New Hampshire. 1st lighthouse district. Corrected to May 1, 1916. 90 p.	800	694	283.37
Same, Narragansett Bay to Cape May, including New York Harbor. 3d lighthouse district. Corrected to May 1, 1917. 126 p.	6,500	4,843	942.92
Same, Delaware Bay and River, including Philadelphia Harbor. 4th lighthouse district. Corrected to June 1, 1917. 34 p.	7,500	5,252	1,446.52
Gulf coast, buoy list, Cedar Keys to Rio Grande. 8th lighthouse district. Corrected to Sept. 1, 1916. 71 p.	4,750	3,773	335.47
West Indies, buoy list, Porto Rico and adjacent islands. 9th lighthouse district. [Includes Guantanamo Bay on south coast of Cuba.] Corrected to Nov. 1, 1915. [Reprint.] 20 p.	4,000	2,876	704.35
Great Lakes, buoy list, Lake Erie and Lake Ontario, and St. Lawrence River. 10th lighthouse district. Corrected to Apr. 1, 1917. 32 p.	175	175	6.09
Same, Lake Huron, Lake Superior, and connecting waters. 11th lighthouse district. Corrected to Apr. 1, 1917. 62 p.	1,800	1,195	211.55
Same, Lake Michigan and Green Bay. 12th lighthouse district. Corrected to Apr. 1, 1917. 39 p.	2,000	1,100	531.25
Corrections to 10th, 11th, and 12th lighthouse districts buoy lists, 1915. Corrected to July 1, 1916. 14 p.	2,500	1,125	349.89
Pacific coast, buoy list, Alaska. 16th lighthouse district. Corrected to June 1, 1917. 36 p.	1,500	1,500	67.11
Same, Oregon and Washington. 17th lighthouse district. Corrected to June 1, 1916. 53 p.	1,000	465	315.03
Same, California. 18th lighthouse district. Corrected to June 1, 1916. 33 p.	2,000	1,258	476.38
Two-hundredth anniversary of Boston Light, Sept. 25, 1916. 13 p. 2 pl. 7x10"	2,000	1,315	260.12
Proposal for repairs, additions, and alterations to vessels. (Form 127.) [Reprint.] 16 p. 8x10½"	1,000	620	55.49
Eight-hour law; additional conditions. (Form 120a.) [Reprint.] 1 p. 8x10½"	3,000	2,991	52.65
	1,000	960	2.81

## BUREAU OF NAVIGATION.

Annual report of Commissioner, 1916. [Printed also as H. doc. 1491, 64th Cong. 2d sess.] 245 p.	1,000	940	\$1,992.46
47th annual list of merchant vessels of United States, with official numbers and signal letters, and lists of vessels belonging to Government, with distinguishing signals, year ended June 30, 1915. [pts. 1-5.] [Reprint.] 490 p. 8½x9½"	500	500	461.35
48th annual list of merchant vessels of United States, with official numbers and signal letters, and lists of vessels belonging to Government, with distinguishing signals, year ended June 30, 1916. [pts. 1-5.] 494 p. 8½x9½"	5,000	5,000	7,127.78
Same. [6 pts.] [Printed as H. doc. 1382, 64th Cong. 2d sess.] 620 p. 14 pl. 53 text fig. 8½x9½"	(a)	(a)	(a)
Seagoing vessels of United States, with official numbers and signal letters, 1916; pt. 6 of 48th annual list of merchant vessels of United States, year ended June 30, 1916. 126 p. 14 pl. 53 text fig. 8½x9½"	5,000	4,982	1,827.92
Same [reprint without illustrations]	500	500	77.98
Navigation laws of United States, 1915. [Reprint.] 585 p.	1,000	534	434.58
Amendments to Navigation laws of United States, 1915. 1st supplement. Sept. 22, 1916. 19 p.	2,500	1,490	68.48
Radio stations of United States. Edition July 1, 1916. 178 p.	3,000	3,000	1,618.52
Radio communication laws of United States and international radiotelegraphic convention [and] Regulations governing operators and use of apparatus on ships and on land. Edition July 27, 1914 [with addenda, Jan. 1, 1917]. [Reprint.] 104 p.	2,500	1,775	137.71
Same [addenda, Jan. 1, 1917]. 4 p.	2,500	1,775	6.45
Radio Service bulletin [issued monthly, July, 1916-Mar. 1917, nos. 19-27, 7-12 p. each]. [Discontinued temporarily Apr. 1, 1917.] 86 p.	26,000	26,000	513.15
Steel-ship building in United States, July 1, 1916. 13 p.	250	240	15.96
Act to establish United States Shipping Board [Public, No. 260, 64th Cong.] 12 p.	3,000	1,200	21.38

• None printed for the Department.



PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF STANDARDS.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Annual report of Director, 1916. 165 p. 1 paster.....	1,000	684	\$500.44
Bulletin, v. 12, no. 1. Oct. 28, 1915. [Reprint.] 190 p. 3 pl. 58 text fig. 7x10".....	500	152	134.65
CONTENTS.—Temperature coefficient of magnetic permeability within working range; [by] R. L. Sanford.—Methods of measuring inductances of low-resistance standards; [by] Frank Wenner, Ernest Weibel, and F. B. Silsbee.—Aneroid calorimeter; [by] H. C. Dickinson and N. S. Osborne.—Specific heat and heat of fusion of ice; [by] H. C. Dickinson and N. S. Osborne.—Emissivity of metals and oxides; 4, Iron oxide; [by] George K. Burgess and Paul D. Foote.—Characteristics of radiation pyrometers; [by] George K. Burgess and Paul D. Foote.			
Same, v. 12, no. 2. Nov. 8, 1915. [Reprint.] 150 p. 2 pl. 2 p. of pl. 28 text fig. 7x10".....	500	305	119.35
CONTENTS.—Interference measurements of wave lengths in iron spectrum (2851-3701), with Notes on comparisons of lengths of light waves by interference methods, and some wave lengths in spectrum of neon gas; [articles by] Kelvin Burns and W. F. Meggers.—Effective resistance and inductance of iron and bimetallic wires; [by] John M. Miller.—Direct-reading device for use in computing characteristics of vacuum tungsten lamps [with computing chart]; [by] J. F. Skogland.—Study of quality of platinum ware [with selected bibliography and miscellaneous reference list]; [by] George K. Burgess and P. D. Foote.			
Same, v. 12, no. 3. Feb. 3, 1916. [Reprint.] 178 p. 3 pl. 24 text fig. 7x10".....	500	155	129.53
CONTENTS.—Calculation of maximum force between 2 coaxial circular currents; [by] Frederiek W. Grover.—Construction of primary mercurial resistance standards; [by] F. A. Wolff, M. P. Shoemaker, and C. A. Briggs.—Note on resistance of radiotelegraphic antennas; [by] L. W. Austin.—Method of measuring earth resistivity; [by] Frank Wenner.—New relation derived from Planck's law; [by] Paul D. Foote.			
Same, v. 12, nos. 1-4, 1915-16 [title-page and contents]. 4 p. 7x10".....	1,500	1,161	10.52
Same, v. 13, no. 2. Aug. 19, 1916. 183 p. 3 p. of pl. 53 text fig. 7x10".....	1,500	1,308	280.57
CONTENTS.—Correlation of magnetic and mechanical properties of steel; [by] Charles W. Burrows.—General design of critically damped galvanometers; [by] Frank Wenner.—Interference measurements of wave lengths in iron spectrum (3233A-6750A); [by] Kelvin Burns, W. F. Meggers, and Paul W. Merrill.—Relation between composition and density of aqueous solutions of copper sulphate and sulphuric acid; [by] H. D. Holler and E. L. Peffer.—Protected thermocouples; [by] Arthur W. Gray.—An interlaboratory photometric comparison of glass screens and of tungsten lamps, involving color differences; [by] G. W. Middlekauff and J. F. Skogland.—An investigation of laws of plastic flow; [by] Eugene C. Bingham.			
Same, v. 13, no. 3. Dec. 30, 1916. 162 p. 6 pl. 33 text fig. 7x10".....	1,500	1,292	264.40
CONTENTS.—Distribution of energy in visible spectrum of an acetylene flame; [by] W. W. Coblentz and W. B. Emerson.—Further experiments on volatilization of platinum; [by] G. K. Burgess and R. G. Wattenberg.—Study of inductance of 4-terminal resistance standards; [by] Francis B. Silsbee.—Sensitivity and magnetic shielding tests of Thomson galvanometer for use in radiometry; [by] W. W. Coblentz.—Volume effect in silver voltameter; [by] E. B. Rosa and G. W. Vinal.—Constants of spectral radiation of uniformly heated inclosure or so-called black body, II; [by] W. W. Coblentz.—Summary of experiments on silver voltameter at Bureau of Standards and proposed specifications; [by] E. B. Rosa and G. W. Vinal.			
Same, v. 13, no. 4. Mar. 6, 1917. 153 p. 2 pl. 2 p. of pl. 30 text fig. 7x10".....	1,500	358	281.31
CONTENTS.—Determination of aluminum as oxide; [by] William Blum.—Calculation of Planck's constant $C_2$ ; [by] J. H. Dellinger.—Wheatstone bridges and some accessory apparatus for resistance thermometry; [by] E. F. Mueller.—Damping of waves and other disturbances in mercury; [by] M. H. Stillman.—Variable self and mutual inductor; [by] H. B. Brooks and F. C. Weaver.—System of remote control for electric testing laboratory; [by] P. G. Agnew, W. H. Stannard, and J. L. Fearing.—International system of electric and magnetic units; [by] J. H. Dellinger.—Saccharimetric normal weight and specific rotation of dextrose; [by] Richard F. Jackson.—Freezing point of mercury; [by] R. M. Wilhelm.—[Index to v. 13.]			
Same, v. 13, nos. 1-4, 1916-17 [title-page and contents]. 4 p. 7x10".....	1,500	215	15.2
Scientific papers [reprints from Bulletin; all 7x10"]:			
117. Determination of magnetic induction in straight bars; by Charles W. Burrows. May 1, 1909. [Reprint.] 60 p. 29 text fig.	500	96	55.16
169. Formulas and tables for calculation of mutual and self inductance [revised]; by E. B. Rosa and F. W. Grover. [3d edition.] Dec. 18, 1916. 239 p. 55 text fig.	1,000	373	282.73
Same, correction sheet [corrections to 1911 edition (both in Bulletin and Reprint) and corrections to all editions previous to 3d edition]. 3 p.	2,000	426	10.36

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF STANDARDS—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
<b>Scientific papers—Continued.</b>			
205. Melting points of refractory elements: I, Elements of atomic weight from 48 to 59; by G. K. Burgess and R. G. Waltenberg. Apr. 25, 1913. [Reprint.] 14 p. 2 pl.	600	159	\$21.90
253. Direct-reading device for use in computing characteristics of vacuum tungsten lamps, with computing chart; by J. F. Skogland. July 31, 1915. [Reprint.] 22 p. 1 chart, 1 text fig.	500	60	21.77
254. Study of quality of platinum ware [with selected bibliography]; by George K. Burgess and P. D. Sale. Aug. 25, 1915. [Reprint.] 30 p. 2 p. of pl. 4 text fig.	250	58	23.81
258. Method of measuring earth resistivity; by Frank Wenner. Oct. 11, 1915. [Reprint.] 11 p. 4 text fig.	250	52	9.40
268. Constants of quartz-wedge saccharimeter and specific rotation of sucrose: I, Constants for 26-gram normal weight; by Frederick Bates and Richard F. Jackson. Apr. 6, 1916. [Reprint.] 64 p. 9 text fig.	250	54	33.89
280. Further experiments on volatilization of platinum; [by] G. K. Burgess and R. G. Waltenberg. June 16, 1916. [Reprint.] 10 p. 2 text fig.	500	500	9.28
281. Study of inductance of 4-terminal resistance standards; by Francis B. Silsbee. July 12, 1916. 50 p. 17 text fig.	1,000	714	346.42
282. Sensitivity and magnetic shielding tests of Thomson galvanometer for use in radiometry; by W. W. Coblenz. June 30, 1916. 26 p. 2 pl. 6 text fig.	1,000	214	130.37
283. Volume effect in silver voltameter; by E. B. Rosa and G. W. Vinal. July 10, 1916. 13 p. 3 text fig.	1,000	494	61.29
284. Constants of spectral radiation of uniformly heated inclosure or so-called black body, II; by W. W. Coblenz. July 8, 1916. 21 p. 2 text fig.	500	286	104.75
285. Summary of experiments on silver voltameter at Bureau of Standards and proposed specifications [with bibliography and errata to preceding papers]; by E. B. Rosa and G. W. Vinal. Oct. 5, 1916. 38 p. 4 pl.	1,000	830	225.17
286. Determination of aluminum as oxide; by William Blum. Aug. 10, 1916. 22 p. 2 text fig.	500	457	94.66
287. Calculation of Planck's constant $C_2$ ; by J. H. Dellinger. Aug. 16, 1916. 12 p. 1 text fig.	1,000	122	53.24
288. Wheatstone bridges and some accessory apparatus for resistance thermometry; by E. F. Mueller. Oct. 23, 1916. 17 p. 1 p. of pl. 8 text fig.	1,000	652	118.56
289. Damping of waves and other disturbances in mercury; by M. H. Stillman. Sept. 30, 1916. 7 p. 3 text fig.	1,000	544	32.49
290. Variable self and mutual inductor; by H. B. Brooks and F. C. Weaver. Oct. 12, 1916. 14 p. 1 pl. 1 p. of pl. 5 text fig.	1,000	845	86.21
291. System of remote control for electric testing laboratory; by P. G. Agnew, W. H. Stannard, and J. L. Fearing. Oct. 12, 1916. 19 p. 1 pl. 9 text fig.	1,000	831	97.14
292. International system of electric and magnetic units; by J. H. Dellinger. Oct. 11, 1916. 35 p.	1,500	1,232	249.39
293. Saccharimetric normal weight and specific rotation of dextrose; by Richard F. Jackson. Oct. 27, 1916. 23 p. 1 text fig.	1,000	220	117.63
294. Freezing point of mercury; by R. M. Wilhelm. Oct. 26, 1916. 8 p. 2 text fig.	1,000	239	41.80
296. Determination of degree of uniformity of bars for magnetic standards; by Raymond L. Sanford. Nov. 21, 1916. 16 p. 1 pl. 11 text fig.	1,000	964	77.21
296. Thermoelectric measurement of critical ranges of pure iron; by George K. Burgess and H. Scott. Nov. 22, 1916. 8 p. 3 text fig.	1,200	116	44.07
297. Study of electromagnet moving coil galvanometers for use in alternating-current measurements; by Ernest Walbel. Feb. 17, 1917. 38 p. 2 pl. 7 text fig.	1,000	587	230.68
298. Standard substances for calibration of viscometers; by Eugene C. Bingham and Richard F. Jackson. Mar. 19, 1917. 30 p. 5 text fig.	1,000	403	193.00
299. "Average eye" for heterochromatic photometry, and comparison of flicker and equality-of-brightness photometer; by E. C. Crittenden and F. K. Richtmyer. May 26, 1917. 29 p. 7 text fig.	750	341	126.48
300. Emissivity of straight and helical filaments of tungsten; by W. W. Coblenz. June 8, 1917. 19 p. 1 pl. 4 text fig.	750	346	97.95
302. Wave lengths of stronger lines in helium spectrum; by Paul W. Merrill. June 18, 1917. 8 p.	500	305	39.39
304. Calculation of constants of Planck's radiation equation: Extension of theory of least squares; by Harry M. Roeser. June 29, 1917. 19 p. 1 text fig.	500	233	112.33
305. Luminous radiation from black body and mechanical equivalent of light [with bibliography]; by W. W. Coblenz and W. B. Emerson. June 30, 1917. 14 p.	750	303	91.19

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF STANDARDS—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Circulars [all 7x10"]:			
5. Testing of clinical thermometers. 2d edition. June 30, 1911. [Reprint.] 14 p.	500	500	\$14.05
6. Fees for electric, magnetic, and photometric testing. 6th edition. Oct. 1, 1914. [Reprint.] 27 p.	500	500	24.37
Same. 7th edition. Dec. 30, 1916. 30 p.	1,000	1,000	118.53
Same [reprint].	1,000	84	34.56
9. Testing of glass volumetric apparatus. 8th edition. Mar. 31, 1916. [Reprint.] 32 p. 10 text fig.	500	298	25.81
11. Standardization of bomb calorimeters. 3d edition. June 23, 1917. 18 p.	500	339	40.77
13. Standard specifications for incandescent electric lamps. 7th edition. Oct. 25, 1915. [Reprint.] 14 p.	500	196	14.87
14. Analyzed irons and steels, methods of analysis. 5th edition. Mar. 20, 1916. [Reprint.] 17 p.	500	500	17.46
Same [reprint].	500	500	17.81
16. Testing of hydrometers. 4th edition. Feb. 23, 1916. [Reprint.] 16 p. 1 p. of pl. 1 text fig.	500	297	17.69
17. Magnetic testing. 3d edition. Mar. 18, 1916. [Reprint.] 50 p. 1 pl. 22 text fig.	500	500	40.53
Same [reprint].	1,000	97	68.58
18. Standard gage for sheet and plate iron and steel. 2d edition. July 1, 1911. [Reprint.] 4 p.	500	251	3.05
19. Standard density and volumetric tables. 5th edition. Mar. 30, 1916. [Reprint.] 67 p.	1,000	259	72.11
24. Publications of Bureau of Standards; supplement to 4th edition, giving complete supplementary list of Bureau's publications to Sept. 15, 1916. 4 p.	3,000	3,000	17.55
25. Standard samples, general information. 6th edition. (Supersedes former editions numbered 1-5 under title "Standard analyzed samples, general information.") June 20, 1917. 16 p.	500	217	51.32
Standard analyzed samples issued or in preparation. Insert to accompany Circular 25. 4 p.	2,500	2,500	38.96
Standard samples issued or in preparation. Supplement to Circular 25. May 26, 1917. 4 p.	500	500	29.58
26. Analyzed iron and manganese ores, methods of analysis. 3d edition. May 26, 1913. [Reprint.] 20 p.	1,000	396	28.73
30. Lime, its properties and uses. 1st edition. Apr. 15, 1911. [Reprint.] 22 p.	1,000	322	29.63
33. United States Government specification for Portland cement. 2d edition. July 1, 1913. [Reprint.] 28 p. 10 text fig.	500	500	23.91
Same. 3d edition. Jan. 18, 1917. 43 p. 2 p. of pl. 7 text fig.	2,000	2,000	207.29
Same [reprint].	3,000	2,141	95.95
36. Testing and properties of electric condensers. 1st edition. June 30, 1912. [Reprint.] 26 p. 1 chart, 2 text fig.	500	233	42.76
40. Sodium oxalate as standard in volumetric analysis. 2d edition. May 15, 1913. [Reprint.] 13 p.	500	313	14.06
47. Units of weight and measure: Definitions and tables of equivalents. 1st edition. July 1, 1914. (Supersedes Tables of equivalents of United States customary and metric weights and measures.) [Reprint with corrections.] 68 p.	3,000	1,734	193.09
50. National standard hose couplings and fittings for public fire service. 2d edition. June 8, 1917. 34 p. 1 p. of pl. 4 text fig.	500	115	137.15
52. Regulation of electrolytic solutions. 2d edition. June 28, 1916. [Reprint.] 44 p. 1 text fig.	1,000	537	51.28
54. National electrical safety code [for examination, trial, and constructive criticism]. 2d edition. Nov. 15, 1916. 323 p. 1 map, 15 text fig.	1,500	1,382	1,714.27
55. Measurements for household. 1st edition. Aug. 28, 1915. [Reprint.] 149 p. 6 pl. 2 p. of pl. 52 text fig.	5,000	5,000	605.46
56. Standards for electric service [with selected bibliography]. 1st edition. July 28, 1916. 262 p.	5,000	5,000	1,863.24
Same [reprint].	1,000	342	253.79
57. United States standard tables for petroleum oils. 2d edition. May 11, 1916. [Reprint.] 64 p. 2 text fig.	1,000	206	65.99
58. Invar and related nickel steels [with selected bibliography]. 1st edition. Apr. 4, 1916. [Reprint.] 68 p. 1 p. of pl. 37 text fig.	1,000	1,000	81.35
Same [reprint].	1,000	513	83.39
60. Electrical units and standards [with bibliography]. 1st edition. Sept. 25, 1916. 68 p.	2,500	2,088	377.57
61. Specifications and tolerances for weights and measures and weighing and measuring devices, as adopted by 11th annual conference on weights and measures of United States, held at Bureau May 23-26, 1916, and recommended by Bureau for adoption by States. Nov. 13, 1916. 44 p. 2 text fig.	2,500	2,500	257.98

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
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## BUREAU OF STANDARDS—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
<b>Circulars—Continued.</b>			
62. Specifications for and methods of testing soaps. Dec. 16, 1916. 25 p. ....	1,000	1,000	\$109.60
Same [reprint]. ....	1,000	309	36.43
63. Specification of transparency of paper and tracing cloth. 1st edition. May 17, 1917. 8 p. 2 pl. 2 text fig. ....	300	300	57.98
64. Rules and regulations for enforcement of lime-barrel act. Apr. 20, 1917. 7 p. ....	2,000	956	30.50
<b>Technologic papers [all 7x10"]:</b>			
5. Effect of high-pressure steam on crushing strength of Portland cement mortar and concrete; by Rudolph J. Wig. Sept. 5, 1911. [Reprint.] 25 p. 1 pl. 1 p. of pl. 6 text fig. ....	500	210	30.59
8. Rapid method for determination of vanadium in steels, ores, etc., based on its quantitative inclusion by phosphomolybdate precipitate; by J. R. Cain and J. C. Hostetter. Oct. 26, 1911. [Reprint.] 20 p. 2 text fig. ....	500	250	17.87
11. Comparison of five methods used to measure hardness; by Ralph P. Devries. July 22, 1912. [Reprint.] 27 p. 1 pl. 11 text fig. ....	500	435	35.53
13. Evaporation test for mineral lubricating and transformer oils; by C. E. Waters. Jan. 1, 1913. [Reprint.] 13 p. ....	500	281	14.42
21. Dehydration of clays; by G. H. Brown and E. T. Montgomery. Apr. 25, 1913. [Reprint.] 23 p. 9 text fig. ....	500	275	22.38
26. Earth resistance and its relation to electrolysis of underground structures; by Burton McCollum and K. H. Logan. Dec. 20, 1916. [Reprint.] 48 p. 17 text fig. ....	500	500	27.97
28. Methods of making electrolysis surveys; by Burton McCollum and G. H. Ahlborn. Aug. 26, 1916. 84 p. 1 pl. 1 p. of pl. 16 text fig. Same [reprint]. ....	1,000 1,000	1,000 683	382.94 94.66
32. Special studies in electrolysis mitigation: 2. Electrolysis from electric railway currents and its prevention, experimental test on system of insulated negative feeders in St. Louis; by E. B. Rosa, Burton McCollum, and K. H. Logan. Dec. 27, 1913. [Reprint.] 34 p. 2 maps. ....	1,000	434	51.67
37. Iodine number of linseed and petroleum oils; by W. H. Smith and J. B. Tuttle. Apr. 28, 1914. [Reprint.] 17 p. 7 text fig. ....	500	81	18.81
52. Electrolysis and its mitigation; by E. B. Rosa and Burton McCollum. Dec. 27, 1915. [Reprint.] 143 p. 3 p. of pl. 37 text fig. ....	500	500	113.61
53. Investigation of fusible tin boiler plugs; by George K. Burgess and Paul D. Merica. Oct. 15, 1915. [Reprint.] 37 p. 1 pl. 7 p. of pl. 2 text fig. ....	500	47	47.92
55. Special studies in electrolysis mitigation: 4. Preliminary report on electrolysis mitigation in Elyria, Ohio, with recommendations for mitigation; by Burton McCollum and K. H. Logan. Jan. 22, 1916. [Reprint.] 49 p. 4 pl. map, 5 text fig. ....	1,000	129	120.71
58. Strength and other properties of concretes as affected by materials and methods of preparation; by R. J. Wig, G. M. Williams, and E. R. Gates. June 20, 1916. [Reprint.] 172 p. 2 pl. 44 text fig. ....	4,000	2,277	505.74
59. Standard test specimens of zinc bronze (Cu 88, Sn 10, Zn 2): pt. 1, Preparation of specifications, by C. P. Karr; pt. 2, Microstructure, by Henry S. Rawdon. Mar. 15, 1916. [Reprint.] 67 p. paster, 8 p. of pl. 8 text fig. ....	500	424	81.48
60. Microstructural changes accompanying annealing of cast bronze (Cu 88, Sn 10, Zn 2); by Henry S. Rawdon. Jan. 25, 1916. [Reprint.] 17 p. 4 p. of pl. 1 text fig. ....	500	229	37.01
61. Some foreign specifications for railway materials, rails, wheels, axles, tires; by G. K. Burgess and P. D. Merica. Apr. 20, 1916. [Reprint.] 152 p. 11 text fig. ....	1,500	1,064	167.32
64. Determination of barium carbonate and barium sulphate in vulcanized rubber goods; by John B. Tuttle. Jan. 21, 1916. [Reprint.] 6 p. ....	500	172	4.80
68. Standardization of automobile tire fabric testing; by Walter S. Lewis and Charles J. Cleary. Mar. 17, 1916. [Reprint.] 18 p. 1 pl. 7 text fig. ....	500	87	25.01
70. Durability of stucco and plaster construction [progress report containing results of investigations up to Apr. 1916]; by R. J. Wig, J. C. Pearson, and W. E. Emley. Jan. 31, 1917. 74 p. 4 pl. 12 p. of pl. paster, 6 text fig. ....	2,500	1,742	651.45
72. Influence of frequency of alternating or infrequently reversed current on electrolytic corrosion; by Burton McCollum and G. H. Ahlborn. Aug. 15, 1916. 31 p. 1 p. of pl. 5 text fig. ....	1,000 1,000	1,000 214	165.14 40.77
74. Investigation of cartridge-inclosed fuses: Report of Bureau in case of Economy Fuse & Manufacturing Co. v. Underwriters' Laboratories (Inc.), concerning fire and accident hazard of Economy reliable fuse as compared with approved fuses; by E. B. Rosa, H. B. Brooks, Burton McCollum, W. J. Canada, and F. W. Glading. Dec. 1, 1916. 213 p. 11 pl. ....	1,000	916	1,202.33

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## BUREAU OF STANDARDS—Continued.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Technologic papers—Continued.			
75. Data on electric railway track leakage; by G. H. Ahlborn. Aug. 22, 1916. 22 p. 7 text fig. ....	1,000	1,000	\$121.46
Same [reprint]. ....	1,000	210	20.28
77. Density and thermal expansion of American petroleum oils; by H. W. Bearce and E. L. Pepper. Aug. 26, 1916. 26 p. 4 text fig. ....	1,000	881	182.20
78. Properties of calcium silicates and calcium aluminate occurring in normal Portland cement; by P. H. Bates and A. A. Klein. June 9, 1917. 38 p. 10 p. of pl. 1 text fig. ....	1,000	1,000	858.06
79. Properties of some European plastic fire clays; by A. V. Bleining and H. G. Schurecht. Aug. 24, 1916. 34 p. 4 text fig. ....	1,000	987	139.91
80. Constitution and microstructure of porcelain; by A. A. Klein. Dec. 8, 1916. 38 p. 1 pl. 14 p. of pl. 1 text fig. ....	1,000	1,000	258.08
81. Liquid-measuring pumps; by F. J. Schlunk. Oct. 27, 1916. 27 p. 1 pl. 6 p. of pl. 11 text fig. ....	1,500	1,500	227.28
82. Failure of brass: 1. Microstructure and initial stresses in wrought brasses of type 60 per cent copper and 40 per cent zinc; by Paul D. Merica and R. W. Woodward. Jan. 29, 1917. 72 p. 4 pl. 36 p. of pl. 2 text fig. ....	1,000	1,000	748.04
83. Failure of brass: 2. Effect of corrosion on ductility and strength of brass; by Paul D. Merica. Nov. 14, 1916. 8 p. 3 text fig. ....	1,000	1,000	34.08
Same [reprint]. ....	500	104	8.37
84. Failure of brass: 3. Initial stress produced by "burning in" of manganese bronze; by Paul D. Merica and C. P. Karr. Nov. 17, 1916. 8 p. 1 p. of pl. 1 text fig. ....	1,000	1,000	49.28
Same [reprint]. ....	500	43	12.39
85. Manufacture and properties of sand-lime brick; by Warren E. Emley. Mar. 22, 1917. 41 p. 1 pl. 6 p. of pl. 1 text fig. ....	1,000	544	220.24
86. Resistance of an oil to emulsification; by Winslow H. Herschel. Feb. 17, 1917. 37 p. 1 pl. 7 text fig. ....	500	500	161.06
87. Recovery of paraffin and paper stock from waste paraffin paper; by W. H. Smith. Dec. 15, 1916. 4 p. ....	500	500	12.09
Same [reprint]. ....	300	89	2.67
88. Studies on paper pulps; by W. H. Smith. Feb. 9, 1917. 13 p. ....	500	396	47.98
89. Specific gravity balance for gases; by Junius David Edwards. Feb. 23, 1917. 20 p. 2 pl. 4 text fig. ....	750	750	108.55
90. Structure of coating on tinned sheet copper in relation to specific case of corrosion; by Paul D. Merica. Apr. 21, 1917. 18 p. 1 pl. 5 p. of pl. 1 text fig. ....	500	500	146.06
91. Temperature measurements in Bessemer and open-hearth practice; by George K. Burgess. May 8, 1917. 29 p. 1 diag. ....	750	780	190.90
92. Measurement and specification of physical factors which determine saturation of certain tints of yellow; by Irwin G. Priest and Chauncey G. Peters. June 30, 1917. 12 p. 2 pl. 2 text fig. ....	300	200	115.83
93. Glasses for protecting eyes from injurious radiations; by W. W. Coblenz and W. B. Emerson. May 5, 1917. 14 p. 6 text fig. ....	500	383	60.19
94. Effusion method of determining gas density; by Junius David Edwards. June 20, 1917. 30 p. 1 pl. 11 text fig. ....	1,000	722	165.77
96. Comparative tests of stitches and seams; by Walter S. Lewis. June 25, 1917. 8 p. 2 pl. 1 p. of pl. 3 text fig. ....	750	750	80.80
Publications of Bureau. Oct. 2, 1916. [Reprinted from Department list.] 16 p. ....	1,000	1,000	9.16
Same [reprint]. ....	1,500	1,500	12.75
Same. May 8, 1917. 16 p. ....	3,000	1,205	22.28
Weights and measures, [report of] 11th annual conference of representatives from various States, held at Bureau, Washington, D. C., May 23-26, 1916. [Circular 61 and Technologic paper 81 reprinted and bound in at end of report.] 264 p. 7 pl. 8 p. of pl. 21 text fig. 7x10" ....	2,000	889	1,060.06
Specifications of materials and labor for construction of radio laboratory building for Bureau at Washington, D. C. 72 p. ....	180	180	155.10
Proposal for construction of radio laboratory building for Bureau at Washington, D. C. 9 p. 8x10 1/2" ....	200	200	31.67
Some technical methods of testing miscellaneous supplies, including paints and paint materials, inks, lubricating oils, soaps, etc.; by Percy H. Walker. Nov. 15, 1916. [Reprinted with notes and corrections from Bulletin 109 of Bureau of Chemistry.] 68 p. 3 text fig. 7x10" ....	1,000	371	82.20

PUBLICATIONS ISSUED BY DEPARTMENT OF COMMERCE, AND DISTRIBUTION THEREOF,  
FISCAL YEAR 1917—Continued.

## STEAMBOAT-INSPECTION SERVICE.

Title and description.	Re- ceived.	Dis- tributed.	Cost.
Annual report of Supervising Inspector General, 1916. 47 p.....	1,000	943	\$316.86
General rules and regulations prescribed by board of supervising inspectors: Rule 3, Ocean and coastwise, and Lakes, bays, and sounds, amended Jan. 1915, effective Nov. 4, 1915. Edition Nov. 4, 1915. 71 p. 1 text fig.....	2,000	2,000	50.63
Ocean and coastwise, amended Jan. 1916. Edition May 13, 1916. 192 p. 8 text fig.....	12,000	12,000	1,155.73
Same, further amended June 2-6, 1916. Edition Nov. 21, 1916.* 192 p. 8 text fig.....	10,000	10,000	788.11
Same [reprint].....	5,000	1,128	358.19
Great Lakes, amended Jan. 1916. Edition May 13, 1916. 154 p. 6 text fig.....	6,000	6,000	819.08
Same, further amended June 2-6, 1916. Edition Nov. 21, 1916.* 154 p. 6 text fig.....	5,000	5,000	368.55
Same [reprint].....	5,000	497	300.23
Lakes other than Great Lakes, bays, and sounds, amended Jan. 1916. Edition May 13, 1916. 150 p. 6 text fig.....	10,000	10,000	614.96
Same, further amended June 2-6, 1916. Edition Nov. 21, 1916.* 150 p. 6 text fig.....	5,000	4,943	363.65
Rivers, amended Jan. 1916. Edition May 13, 1916. 144 p. 6 text fig.....	15,000	15,000	1,065.93
Same, further amended June 2-6, 1916. Edition Nov. 21, 1916.* 144 p. 6 text fig.....	5,000	2,807	326.86
Laws governing Steamboat-Inspection Service, Revised Statutes as modified by acts of Congress. Edition Nov. 4, 1915. [Reprint with corrections.] 87 p.....	15,000	15,000	401.89
Same. Edition Nov. 20, 1916. 87 p.....	15,000	14,870	613.24
Pilot rules for certain inland waters of Atlantic and Pacific coasts and coast of Gulf of Mexico. Edition Sept. 1, 1914. [Reprint.] 34 p. 5 text fig.....	50,000	50,000	818.19
Same [reprint].....	50,000	31,831	761.79
Pilot rules for rivers whose waters flow into Gulf of Mexico and their tributaries and Red River of the North. Edition Aug. 1, 1911. [Reprint.] 22 p. 5 text fig.....	5,000	5,000	68.06
Pilot rules for Great Lakes and their connecting and tributary waters. Edition May 1, 1912. [Reprint.] 20 p. 5 text fig.....	15,000	15,000	172.37
Amendments of steamboat-inspection rules and regulations. Mar. 30, 1917. (Circular letter.) 20 p.....	35,000	26,450	336.61
Steamboat-Inspection Service bulletin [issued monthly, July 1, 1916- June 1, 1917, nos. 9-20, 2-4 p. each]. 40 p.....	27,200	27,200	166.55

\* The edition of Nov. 21, 1916, of the four separate pamphlets for the various waters covered by the rules and regulations were also printed under one cover as H. doc. 1437, 64th Cong., 2d sess.

There is listed in the foregoing table a total of 1,192 publications, compared with 1,945 for the same bureaus and offices during the fiscal year 1916, a decrease of 753. The decrease is accounted for by the issue in 1916 by the Bureau of the Census of 789 advance press summaries of the results of the census of manufactures in 1914. Only 36 publications were printed in two or more editions during 1917, against 84 in 1916, while 126, compared with 113 last year, were reprints without change of issues of earlier years. The number of new publications, aside from census press summaries, was therefore larger in 1917 than in 1916, and considerably larger than in any preceding fiscal year.

The publications issued in 1917 contained a total of 54,407 printed pages, compared with 61,702 in 1916, and there were printed of them for the Department a grand total of 4,444,200 copies, against 7,124,035 in the preceding year, a decrease of 2,679,835. This large decrease was due partly to directions issued by the head of the Department that editions of miscellaneous publications be curtailed, and in a larger measure to the fact that in 1916 about 1,500,000 circulars used in the campaign for saving waste paper and 1,200,000 census press summaries, already referred to, were printed and distributed. A growing tendency to lessen the free distribution of the Department's publications also had its effect.

The average edition of the publications in 1917 was 3,728 copies against 3,663 in 1916 and 3,616 in 1915, while the average number of pages in the 1917 publications was 46, compared with 32 in 1916 and 59 in 1915.

The total cost of all publications issued in 1917 was \$316,013.57, compared with \$289,033.53 in 1916.

The following recapitulation of the table, together with summary figures for 1915 and 1916, is submitted for comparative purposes:

Bureau or office. <sup>a</sup>	Publications.			Pages.		
	1915	1916	1917	1915	1916	1917
Office of the Secretary.....	64	77	78	2,237	2,428	3,006
Bureau of the Census.....	138	836	135	19,937	14,165	13,161
Coast and Geodetic Survey.....	29	56	62	3,197	3,960	3,067
Bureau of Fisheries.....	57	81	81	3,159	2,620	2,440
Bureau of Foreign and Domestic Commerce.....	494	575	553	18,708	21,645	17,838
Bureau of Lighthouses.....	87	129	111	3,548	4,361	3,667
Bureau of Navigation.....	17	23	22	2,523	3,207	3,103
Bureau of Standards.....	137	150	122	6,662	8,328	6,623
Steamboat-Inspection Service.....	15	18	28	1,330	968	2,068
Total.....	1,038	1,945	1,192	61,301	61,702	54,667

Bureau or office.	Copies printed for Department.			Cost. <sup>b</sup>		
	1915	1916	1917	1915	1916	1917
Office of the Secretary.....	157,260	261,850	183,550	\$6,055.39	\$6,331.07	\$7,157.60
Bureau of the Census.....	524,625	1,432,910	645,150	97,830.49	54,263.37	92,562.23
Coast and Geodetic Survey.....	55,060	79,760	109,300	21,630.72	23,218.71	26,577.94
Bureau of Fisheries.....	68,200	171,350	339,700	11,902.88	10,339.36	11,661.69
Bureau of Foreign and Domestic Commerce.....	2,108,460	4,359,200	2,411,450	98,937.71	120,450.01	114,937.10
Bureau of Lighthouses.....	258,300	351,175	270,800	25,188.70	21,646.99	18,720.65
Bureau of Navigation.....	55,900	59,950	52,750	12,154.79	17,483.47	14,303.72
Bureau of Standards.....	153,400	203,050	138,300	19,408.79	28,209.20	21,202.22
Steamboat-Inspection Service.....	372,600	204,800	283,200	8,511.23	8,062.35	9,570.44
Total.....	3,753,795	7,124,035	4,444,200	301,620.69	289,033.53	316,013.57

<sup>a</sup> In 1915 the Bureau of Corporations (which has since been merged in the Federal Trade Commission) issued 10 publications, containing 2,550 pages, of which 24,100 copies, costing \$14,319.65, were printed. These figures, however, are excluded from this table and from computations based on figures therein in order to reach more accurate comparisons in the work of the other bureaus and the Department as a whole.

<sup>b</sup> Figures relate to publications actually delivered to the Department during the year; consequently they do not agree with similar figures in a preceding table giving the cost of work done by the Government Printing Office during the fiscal year. Frequently the cost of a publication is charged against allotments for two or more fiscal years.

#### DISTRIBUTION OF PUBLICATIONS.

In explanation of the apparent discrepancy between statistics of distribution in the following statements and those of publications issued, given in a preceding table, it should be stated that a considerable proportion of the publications of the Department are printed for official use only or are distributed through the bureaus or their field offices. The statistics following relate only to distribution by the Division of Publications.

During the last fiscal year 3,593,563 publications and printed circulars of the Department were distributed to the public through the Division of Publications, compared with a total of 3,648,311 during the fiscal year 1916. Of the total number distributed in 1917, 3,154,108 were wrapped and mailed by the Superintendent of Documents and 439,455 by the Division of Publications. Those wrapped

and mailed by the Superintendent of Documents comprised a mailing list distribution of 2,479,240 and a distribution in response to individual requests of 674,868.

There were received and acted on during the year 106,301 miscellaneous requests, calling for 891,971 copies of publications, compared with 104,833 requests, calling for 605,110 copies, in 1916. This was an average of 354 requests and 2,973 publications for each working day, against an average of 349 requests and 2,017 publications during the preceding year.

The number of publications distributed each month during the past three fiscal years is shown in the following table:

Month.	Mailed by Division.			Mailed by Superintendent of Documents.			Total.		
	1915	1916	1917	1915	1916	1917	1915	1916	1917
July.....	20,209	30,356	50,668	101,292	185,235	216,879	121,501	215,591	267,547
August.....	173,313	32,176	19,733	164,398	259,428	359,800	337,711	291,604	379,533
September.....	18,628	35,493	10,415	193,286	273,979	297,628	211,914	309,472	808,043
October.....	14,527	42,299	21,286	163,964	377,136	290,363	178,491	419,435	311,649
November.....	9,385	47,610	27,241	169,806	292,384	274,623	179,191	339,994	301,864
December.....	11,661	29,226	24,637	171,656	333,243	231,637	183,317	362,469	256,274
January.....	25,750	19,859	24,784	193,990	220,457	239,300	219,740	240,316	294,094
February.....	21,397	26,323	19,206	187,773	218,551	235,049	209,170	244,874	254,255
March.....	22,702	31,092	52,354	180,978	216,195	185,798	203,680	247,287	238,152
April.....	50,674	26,997	47,017	181,508	317,890	361,556	232,132	347,887	408,573
May.....	34,971	32,071	83,177	168,940	301,766	203,885	203,911	333,837	287,062
June.....	33,962	52,124	58,937	209,224	243,421	257,590	243,186	296,545	316,527
Total.....	437,179	408,626	439,455	2,086,815	3,239,685	3,154,108	2,523,994	3,648,311	3,563,563

Includes 333,965 publications mailed by the Superintendent of Documents for the Bureau of the Census.

The distribution of publications in 1915, 1916, and 1917, by bureaus and offices of issue, is given in the following table:

Bureau or office.	Mailed by Division.			Mailed by Superintendent of Documents.			Total.		
	1915	1916	1917	1915	1916	1917	1915	1916	1917
Office of the Secretary....	159,664	188,273	132,149	3,597	31,661	33,680	163,261	219,934	165,829
Bureau of the Census <sup>a</sup> .....						333,965			333,965
Coast and Geodetic Survey.....	289	5,150	4,825	17,259	43,275	26,231	17,548	48,425	31,066
Bureau of Corporations (Federal Trade Commission) <sup>b</sup> .....	445			16,980	5,826	4,744	17,426	5,826	4,744
Bureau of Fisheries.....	24,425	85,496	140,979	50,563	44,431	93,809	74,988	129,897	234,788
Bureau of Foreign and Domestic Commerce.....	16,091	15,379	73,392	1,610,336	2,637,506	2,217,515	1,626,427	2,652,885	2,290,907
Bureau of Lighthouses.....	13,700	11,620	10,444	245,349	263,922	256,116	259,049	275,542	266,560
Bureau of Navigation.....	54,799	43,630	3,599	32,204	49,462	46,897	87,008	98,082	50,496
Bureau of Standards.....	6,057			108,576	161,681	140,082	114,633	161,681	140,082
Steamboat-Inspection Service.....	161,709	59,118	74,067	1,951	1,921	1,060	163,660	61,039	75,123
Total.....	437,179	408,626	439,455	2,086,815	3,239,685	3,154,108	2,523,994	3,648,311	3,563,563

<sup>a</sup> The Bureau of the Census has charge of the distribution of its own publications. Figures for 1917 were obtained from that Bureau.

<sup>b</sup> Pending the complete organization of the Federal Trade Commission, its publications were distributed by courtesy through the Division of Publications.

A summary of the publications in stock and available for distribution at the close of each of the last five fiscal years, by bureaus and offices of issue, follows. The Division has no records relating to



publications of the Bureau of the Census, which accounts for the absence of figures for that Bureau.

Bureau or office.	1913	1914	1915	1916	1917
Office of the Secretary.....	7,558	14,118	14,546	20,152	17,448
Coast and Geodetic Survey.....	41,285	42,176	35,673	33,714	45,366
Bureau of Fisheries.....	98,031	111,554	112,984	117,964	233,700
Bureau of Foreign and Domestic Commerce.....	50,617	43,440	48,374	60,608	87,975
Bureau of Lighthouses.....	24,839	23,100	21,427	23,546	22,080
Bureau of Navigation.....	7,161	8,243	5,874	2,812	3,257
Bureau of Standards.....	102,418	89,739	131,750	138,435	133,511
Steamboat-Inspection Service.....	169	1,021	315	500	366
Total.....	332,068	333,391	370,893	397,733	535,683

The Department has a large and ever increasing number of different publications of permanent interest and value, of which it is necessary to maintain a supply to meet continuing demands. Many of these are reprinted from time to time to prevent stocks thereof from becoming exhausted. As a result, the number of publications in stock increases from year to year, as shown by the foregoing statement.

#### SALES OF PUBLICATIONS.

The Department limits the free distribution of many of its publications to a few well-defined public and quasi public classes. Others are encouraged to purchase them from the Superintendent of Documents, who maintains supplies of them for sale at nominal prices.

Details relating to the title, number of copies, and price of each publication sold appear in the annual reports of the Superintendent of Documents, from which the Division has compiled summaries of receipts from sales of and subscriptions to publications of the Department of Commerce for the past few years.

The following statement gives the number of copies of miscellaneous publications sold, and receipts therefrom, for each bureau of the Department during the fiscal years 1913 to 1917. To facilitate comparisons, there have been omitted from the table statistics of sales of publications of the Bureau of Corporations, which is not now a part of the Department, having been merged into the Federal Trade Commission on March 15, 1915, in compliance with the act approved September 26, 1914.

Bureau or office.	1913		1914		1915		1916		1917 <sup>a</sup>	
	Cop-ies.	Re-ceipts.	Cop-ies.	Re-ceipts.	Cop-ies.	Re-ceipts.	Cop-ies.	Re-ceipts.	Cop-ies.	Re-ceipts.
Office of the Secretary.....	41	\$11.35	50	\$14.65	84	\$16.95	165	\$27.00	106	\$11.35
Bureau of the Census.....	2,444	948.15	2,130	899.00	1,955	800.10	1,864	986.20	2,081	1,073.25
Coast and Geodetic Survey.....	159	123.30	210	128.45	283	141.70	307	186.25	507	211.08
Bureau of Fisheries.....	406	301.00	13,598	447.65	1,060	244.25	7,286	380.90	7,635	\$32.85
Bureau of Foreign and Domestic Commerce.....	5,448	2,268.20	16,705	5,200.50	29,671	6,127.75	63,420	12,166.62	73,741	14,408.10
Bureau of Lighthouses.....	38	10.15	35	10.70	27	5.35	169	71.50	308	60.13
Bureau of Navigation.....	264	144.95	4,793	780.65	4,608	797.45	6,014	1,445.00	7,308	1,580.55
Bureau of Standards.....	1,572	192.60	3,080	328.25	5,652	1,403.55	10,424	2,465.55	31,258	5,771.05
Steamboat-Inspection Service.....	51	5.20	47	4.40	30	6.40	29	4.35	31	3.39
Total.....	10,423	4,004.90	40,648	7,804.85	43,370	9,603.50	89,768	17,733.97	122,965	23,712.29

<sup>a</sup> Preliminary figures.

The subscriptions to the publications of the Department for the fiscal years 1914 to 1917, and receipts therefrom, are shown in the statement following. During 1911, the first year there was any distribution of the Department's publications on a subscription basis, the receipts amounted to only \$27.10; in 1912 they amounted to \$2,749.75 and in 1913 to \$1,958.55.

Bureau and publication.	1914		1915		1916		1917 *	
	Subscriptions.	Receipts.	Subscriptions.	Receipts.	Subscriptions.	Receipts.	Subscriptions.	Receipts.
Bureau of Foreign and Domestic Commerce:								
Commerce Reports <sup>b</sup> .....	1,621	\$4,046.25	4,253	\$10,562.55	9,920	\$24,709.44	7,280	\$18,127.26
Quarterly Index to Commerce Reports.....	33	13.20	33	12.80	34	11.40	.....	.....
Bound volumes of Commerce Reports.....	214	1,276.50	161	940.50	103	618.00	111	\$37.60
Monthly Summary of the Foreign Commerce of the United States.....	144	228.60	488	723.90	496	736.55	494	741.30
Quarterly Statement of Imported Merchandise Entered for Consumption.....	50	37.50	197	147.75	130	97.05	135	101.05
Sailing Dates of Steamships.....	96	81.50	c 7	2.90	.....	.....	.....	.....
Bureau of Standards: Bulletin.....	87	85.75	195	191.50	236	234.00	305	301.50
Bureau of Navigation:								
Radio Service Bulletin.....	.....	.....	(d)	.....	407	101.65	500	125.15
Supplement to List of Radio Stations of United States.....	84	20.50	373	92.65	.....	.....	.....	.....
Total.....	2,329	5,789.80	5,705	12,674.55	11,326	26,508.09	8,825	19,723.86

\* Preliminary figures.

<sup>b</sup> Prior to Jan. 2, 1915, termed "Daily Consular and Trade Reports."

<sup>c</sup> Publication discontinued with the issue of December, 1914.

<sup>d</sup> 1,881 copies of this bulletin were distributed free to subscribers for the Supplement to the List of Radio Stations, which publication has been discontinued. The Radio Service Bulletin, published monthly, gives in greater detail the data formerly contained in the quarterly Supplement to the List of Radio Stations. The issuance of the Radio Service Bulletin, however, was discontinued with the March, 1917, number for the period of the war.

The tables show that the 1916 high record of sales of the Department's publications was maintained in 1917, while for each of these years receipts were practically double those of any prior year. For the year ended June 30, 1917, 122,965 copies of reports and pamphlets issued by the Department were disposed of by the Superintendent of Documents through miscellaneous sales and 3,402,430 copies by annual subscriptions, a total of 3,525,395 copies. The figures for 1916 were 89,768, 3,280,888, and 3,370,656, respectively. The increases were, in miscellaneous sales, 33,197 copies; in subscriptions, 121,542 copies; and in the total, 154,739 copies.

Receipts from both sales and subscriptions were \$43,437.06 in 1917 and \$44,242.06 in 1916, a decrease of \$805. There were received from miscellaneous sales \$23,713.20 in 1917 and \$17,733.97 in 1916, an increase of \$5,979.23, and from subscriptions \$19,723.86 in 1917 and \$26,508.09 in 1916, a decrease of \$6,784.23.

The figures show an increase in the number of copies sold but a decrease in the total receipts therefrom. The decrease in receipts is accounted for wholly by the smaller number of subscriptions received during the year for the daily Commerce Reports (of which there were only 7,280 in 1917 compared with 9,920 in 1916, or a decrease of 2,640, at \$2.50 each), which in turn was due largely to conditions brought about by the war. These considerably curtailed information

from foreign consular officers ordinarily appearing in the publication and consequently lessened somewhat its actual value to importing and exporting interests. The apparent inconsistency shown by a decrease in the receipts in the face of an increase in the number of copies disposed of is attributable to the fact that many subscriptions received during 1916 ran well into the succeeding year.

#### MAILING LISTS.

On July 1, 1917, there were in the Division 352 mailing lists, containing 278,442 names, compared with 348 lists, with 267,939 names, a year ago. During the year 31,736 names were added to the lists and 21,233 were dropped from them; also 34 new lists were established and 30 were discontinued. There was, therefore, a net increase for the year of 4 lists and 10,503 names. More than 8,000 changes of address of persons on existing mailing lists were also made.

Stencils or plates are in use for 343 lists, with 265,757 names, of which the stencils or plates for 242 lists, with 193,256 names, are preserved in the Division and those for 101 lists, with 72,501 names, are kept in the office of the Superintendent of Documents. A year ago, stenciled or embossed plates were in use for 335 lists, with 254,317 names, of which 209 lists, with 176,419 names, were in the Division, and 126 lists, with 77,898 names, were at the office of the Superintendent of Documents. For 9 lists, comprising 12,685 names, compared with 13 lists, comprising 13,622 names, a year ago, address plates have not been embossed, the lists being preserved in card form only.

#### EDITORIAL WORK.

The editorial force of the Division of Publications (1) reads critically all manuscripts submitted for publication, and makes such emendations or suggestions as seem necessary to secure compliance with the law and the Department's regulations and to assure the maintenance of the Department's standards; (2) supplies or revises titles, lists of contents and illustrations, indexes, abstracts, illustration legends and headlines, etc.; and (3) determines, in accordance with the law and the policies adopted thereunder by the Public Printer, the form and style of the Department's publications. The publications of the Department contain about 55,000 printed pages and approximate in cost \$300,000 per annum. All of them, from copy to final page proof, must receive attention at the hands of the Division. Typewritten letters and documents turned out by the duplicating section, amounting annually to about 8,000 pages, also are read and revised in the editorial section.

#### DUPLICATING WORK.

The addressing and duplicating section of the Division rendered efficient and practical service during the year not only to the various bureaus and offices of the Department, but also to the office of the Provost Marshal General, Liberty Loan Bureau, Council of National Defense, Department of Agriculture, Tariff Commission, Committee on Public Information, and other departments and independent Government establishments.

The machines maintained in the Division for duplicating typewritten letters and documents were utilized for turning out 3,604 jobs

making 7,925 pages of matter, of which 6,589,515 copies were printed. These figures represent an increase of 344, or 11 per cent, in the number of jobs; a decrease of 499, or 6 per cent, in the number of pages; and an increase of 775,625, or 13 per cent, in the number of copies printed. The following statement shows the output of these machines for each month of the last three fiscal years:

Month.	Requisitions.			Pages duplicated.			Copies printed.		
	1915	1916	1917	1915	1916	1917	1915	1916	1917
July.....	209	262	275	409	597	578	196,250	478,376	341,760
August.....	195	180	307	334	647	708	163,185	283,469	410,015
September.....	186	252	283	338	701	799	201,405	366,272	384,067
October.....	251	261	318	642	785	670	271,695	448,415	403,287
November.....	274	288	257	472	695	535	239,223	472,622	391,207
December.....	249	237	330	650	612	705	238,570	437,675	475,961
January.....	299	300	330	703	793	682	269,670	365,155	711,734
February.....	241	244	265	578	633	621	320,700	589,666	753,689
March.....	291	252	317	783	560	746	343,208	605,186	790,705
April.....	349	341	278	779	823	572	349,085	705,751	535,809
May.....	350	357	334	810	909	713	535,219	555,620	729,646
June.....	275	286	320	644	680	602	683,727	405,682	661,635
Total.....	3,169	3,260	3,604	7,142	8,424	7,925	3,816,937	5,813,890	6,589,515

Also the mechanical equipment of the section was utilized by the bureaus during the year for folding 2,062,051 letters and documents (a decrease of 19 per cent), sealing and mailing 1,752,652 envelopes (an increase of 26 per cent), and the addressing of 3,587,791 envelopes, franks, cards, and tags (an increase of 30 per cent).

#### ADVERTISING.

During the fiscal year 1917 the Department expended \$2,191.07 for advertising for proposals for furnishing supplies of various kinds, for construction work, and for the purchase of condemned property. Records pertaining to these advertisements are maintained in the Division of Publications, which makes up the authorizations to publish and checks and approves the vouchers for payment.

The following statement shows for each of the past five years, by bureaus and offices, the number of different advertisements inserted, the number of authorities to publish issued (one authority being made up for each paper authorized to issue each advertisement), the number of insertions authorized, and the total cost of such advertisements:

Bureau or office.	Advertisements inserted.					Authorities to publish issued.				
	1913	1914	1915	1916	1917	1913	1914	1915	1916	1917
Office of the Secretary.....	6	2	3	2	3	22	10	15	10	6
Coast and Geodetic Survey.....		11	23	11	29		29	93	43	73
Bureau of Fisheries.....	6	6	10	11	9	28	27	56	52	33
Bureau of Foreign and Domestic Commerce.....				4	3				14	11
Bureau of Lighthouses.....	21	138	182	186	183	103	454	594	579	546
Bureau of Navigation.....				1					5	
Bureau of Standards.....		2	8	8	10		6	39	29	39
Total.....	33	159	226	223	237	153	526	797	732	706

Bureau or office.	Insertions authorized.					Total cost.				
	1913	1914	1915	1916	1917	1913	1914	1915	1916	1917 *
Office of the Secretary.....	69	26	44	30	18	\$83.76	\$45.20	\$88.08	\$65.85	\$31.02
Coast and Geodetic Survey.....		74	225	122	190		107.16	343.33	190.59	209.75
Bureau of Fisheries.....	80	64	142	135	81	104.39	103.17	174.62	195.80	123.94
Bureau of Foreign and Domestic Commerce.....				42	11				76.67	57.97
Bureau of Lighthouses.....	285	1,226	1,636	1,606	1,406	472.31	1,678.83	2,284.74	1,930.40	1,582.73
Bureau of Navigation.....				20					24.30	
Bureau of Standards.....		18	96	82	106		34.05	217.42	101.27	185.06
<b>Total.....</b>	<b>434</b>	<b>1,408</b>	<b>2,143</b>	<b>2,087</b>	<b>1,816</b>	<b>660.46</b>	<b>1,968.41</b>	<b>3,068.14</b>	<b>2,584.88</b>	<b>2,191.07</b>

\* Figures subject to slight revision owing to a few estimates of cost having been made in cases where newspapers have delayed rendering bills.

The statement shows that there was a small increase in 1917 in the number of advertisements inserted, but slight decreases in the number of authorities issued, the number of insertions authorized, and the total cost. The average number of newspapers used for each advertisement was 2.99 in 1917 and 3.28 in 1916, and the average number of insertions was 2.56 in 1917 and 2.78 in 1916. The average cost for advertising in each case was \$9.25 in 1917 and \$11.75 in 1916, while the average cost per insertion of an advertisement was \$1.21 in 1917 and \$1.29 in 1916.

#### ESTIMATES.

The estimates for the personnel of the Division of Publications, for printing and binding for the Department of Commerce, and for contingent expenses of the Division of Publications for the fiscal year 1919 will be submitted in the usual manner for inclusion in the Department's estimates to Congress. The Division will not ask for an increase in the number of employees, but will recommend a few changes in classifications of positions, with a view to equalizing the number of employees in the several grades from \$900 to \$1,400, inclusive.

The Division will submit an estimate of \$425,000 for printing and binding for the Department in 1919, an increase of \$25,000. In connection therewith, the accompanying table, which shows the expenditures for each of the fiscal years 1913 to 1917, inclusive; average expenditures for the five-year period; suballotments for 1918; and estimates (both of the bureaus and the Division of Publications) for 1919 for printing and binding for the Department of Commerce, by bureaus, offices, and services, is submitted.

## EXPENDITURES FOR PRINTING AND BINDING FOR THE DEPARTMENT OF COMMERCE, BY BUREAUS, OFFICES, AND SERVICES, FOR EACH OF THE FISCAL YEARS 1913-1917; AVERAGE EXPENDITURES FOR THE FIVE-YEAR PERIOD; SUBALLOTMENTS FOR 1918; AND ESTIMATES FOR 1919.

Bureau, office, or service.	Expenditures.					Suballotment for 1918.	Estimates, 1919.	
	1913	1914	1915	1916	1917	Average, 1913-1917.	Bureau.	Division.
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, Chief Clerk, and Division of Publications).....	\$19,408.28	\$12,655.94	\$19,537.58	\$16,581.71	\$15,432.08	\$16,723.12	\$17,000.00	\$17,000.00
Appointing Office.....	1,334.05	383.58	370.22	236.86	373.00	353.74	450.00	400.00
Disbursing Office.....	1,333.75	698.09	412.18	747.23	696.21	737.43	900.00	800.00
Division of Supplies.....	38,270.24	505.43	686.04	601.39	184.85	468.29	225.00	225.00
Bureau of the Census.....	26,526.53	110,758.32	122,302.82	84,766.94	115,971.35	108,449.66	105,225.00	105,225.00
Coast and Geodetic Survey.....	12,897.91	28,837.49	26,345.70	28,736.97	28,685.67	27,838.13	39,262.00	35,000.00
Bureau of Fisheries.....	142,818.07	12,687.49	15,916.27	12,460.20	16,432.46	14,078.87	18,000.00	18,000.00
Bureau of Foreign and Domestic Commerce.....	20,219.62	132,039.95	103,229.74	131,262.35	121,529.73	126,173.57	152,675.00	140,000.00
Bureau of Lighthouses.....	6,716.44	26,580.31	24,438.16	21,080.27	18,569.17	21,971.50	21,055.00	21,055.00
Bureau of Navigation.....	12,130.37	7,268.93	5,853.85	7,208.17	4,771.61	6,369.81	7,000.00	7,000.00
Shipping and Radio Services.....	3,135.02	12,473.34	14,183.07	16,928.50	14,740.06	14,091.24	17,000.00	15,000.00
Bureau of Standards.....	18,278.49	3,540.60	2,977.97	5,373.24	3,081.34	3,621.63	5,000.00	5,000.00
Office of the Supervising Inspector General, Steamboat Inspection Service.....	2,456.71	2,637.22	2,801.64	2,335.03	1,009.08	2,247.04	1,300.00	1,300.00
Steamboat-Inspection Service.....	6,767.34	8,768.90	9,780.49	14,466.86	10,701.05	10,096.83	9,300.00	10,000.00
Customs Service.....	6,832.19	13,353.41	9,287.49	11,169.58	6,775.76	9,503.69	10,000.00	10,000.00
Bureaus and offices separated from the Department <sup>b</sup> .....	88,274.50	94,468.46	17,000.00					
Reserve.....								
Total.....	c 406,724.92	494,700.77	399,999.47	389,838.28	382,602.76		8,995.00	425,000.00
Allotment.....	400,000.00	525,000.00	400,000.00	390,000.00	400,000.00		444,117.00	

<sup>a</sup> Average for four years only. Prior to 1913 printing and binding for the Bureau of the Census was paid for wholly from separate appropriations or allotments. In 1913 only \$38,270.24 was expended for that Bureau from the Department's allotment, though there were other expenditures from appropriations for the Thirteenth Census.

<sup>b</sup> Figures represent, for 1915, expenditures for Bureau of Corporations (now Federal Trade Commission) and, for 1913 and 1914, expenditures for that Bureau and for bureaus, offices, and services transferred to the Department of Labor.

<sup>c</sup> Of this amount \$6,728.06 covers printing for the Bureau of Navigation and the Bureau of the Census for which the Department's allotment was reimbursed from other appropriations.

## ACKNOWLEDGMENTS.

The Chief of the Division of Publications desires to close this report with an acknowledgment of the helpful cooperation of the several bureaus and offices of the Department in accomplishing the results shown in the preceding pages. Only through this cooperation and the loyal service of a splendid corps of employees was it possible to meet the exacting demands made on the Division.

Respectfully,

DAN C. VAUGHAN,  
*Chief, Division of Publications.*

To Hon. WILLIAM C. REDFIELD,  
*Secretary of Commerce.*

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